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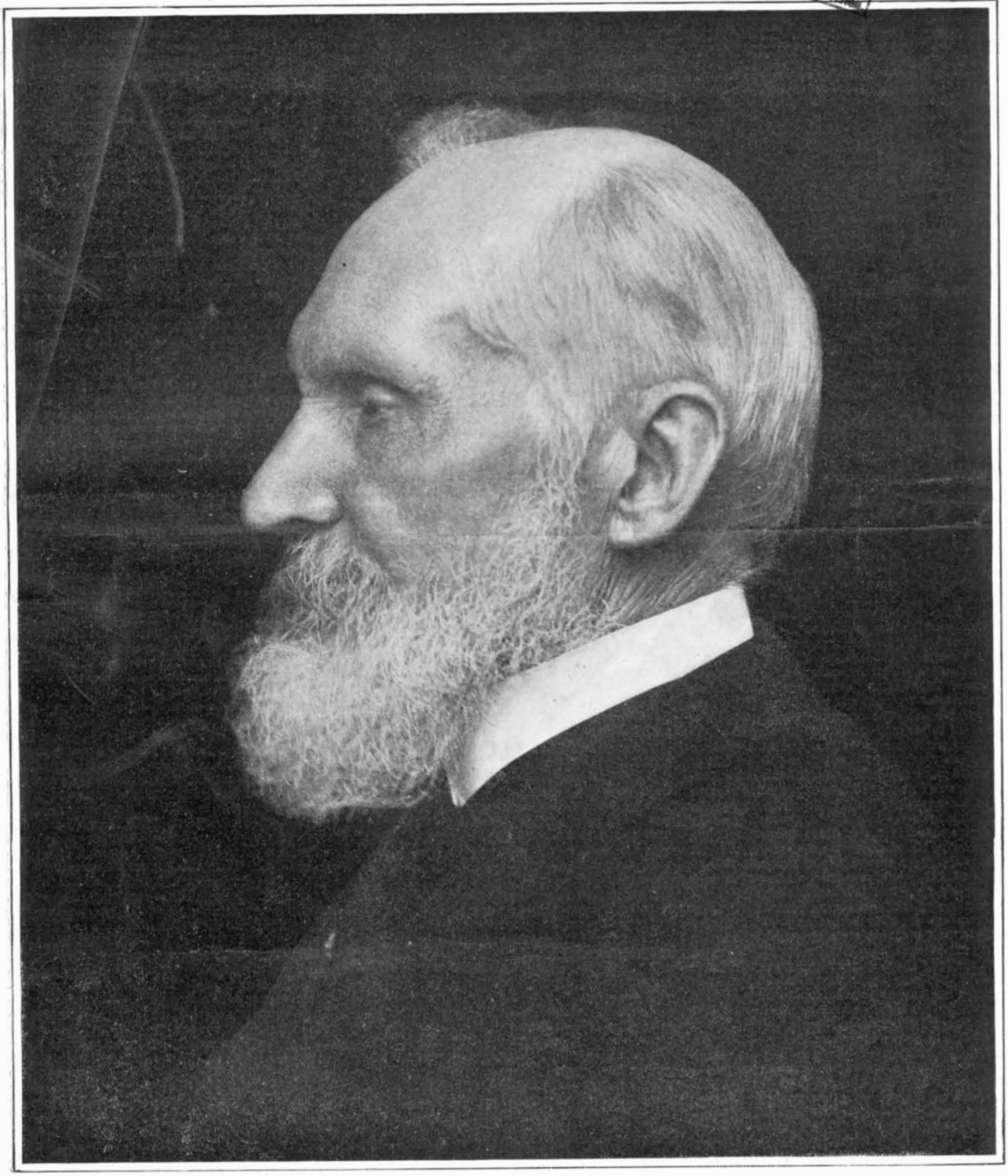
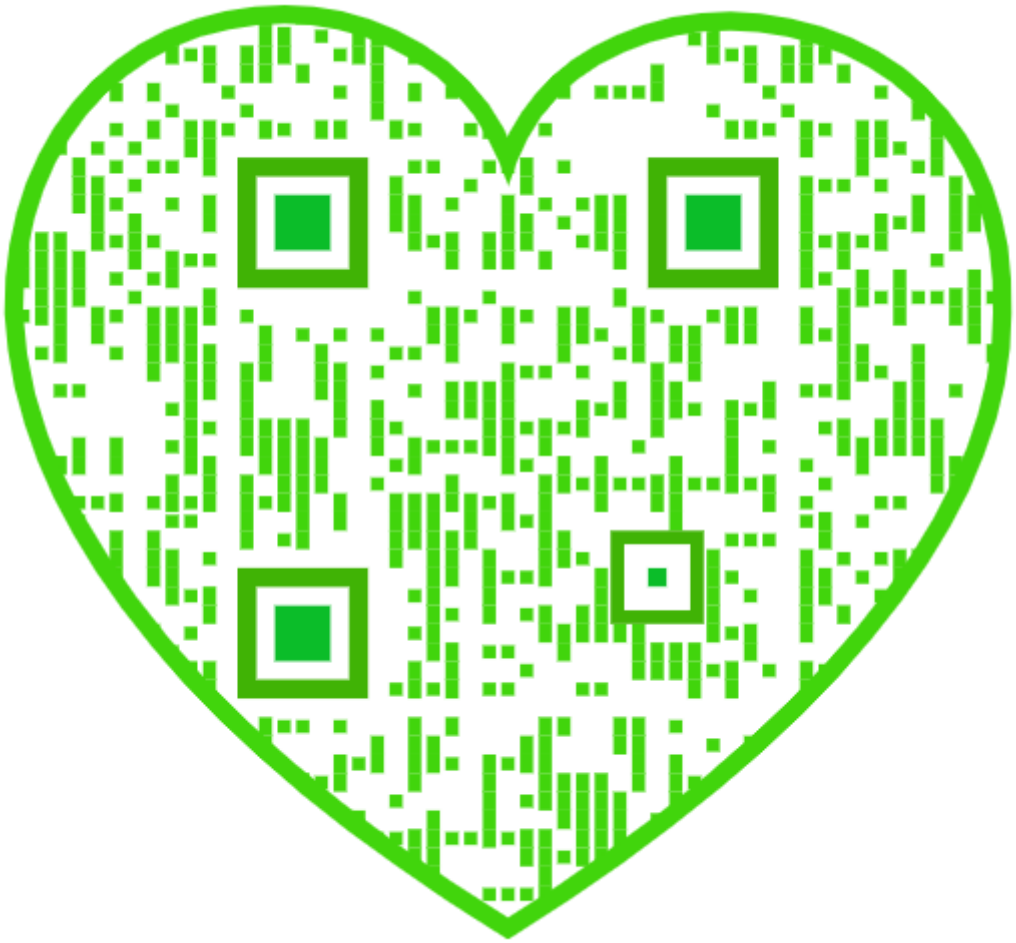


Photo. by Hollinger.

[See page 162.]

Kelvin



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NEW YORK, SATURDAY, FEBRUARY 25, 1905.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

TURBINES FOR TRAMP STEAMERS.

The subject of the unsuitability of the turbine as a drive for ships of slow speed, that is, of speeds of about 9 or 10 knots an hour, at which the average tramp steamer travels, was recently discussed in the course of his presidential address before the Institute of Marine Engineers, by the Hon. C. A. Parsons, the man who, better than anyone else, is qualified to speak on this subject. The problem of turbine propulsion of ships at low speed presents the following dilemma: In a slow vessel the revolutions must be low, because a certain disk area and a certain blade area are necessary in the propeller if we are to avoid too great a slip ratio; but the pitch ratio cannot be reduced much below 0.8 without incurring excessive skin friction of the blades. This makes it necessary to use the highest revolutions possible under the circumstances, and these, in a 10-knot vessel, are necessarily very low. On the other hand, a certain surface speed of the turbine blades and a certain number of rows of blades are necessary to obtain a reasonable economy from a turbine; and if the revolutions are low, the diameter, and the number of rows must be increased. The result is that, for a speed of 10 knots, the diameter and the number of rows become inordinately great; the weight and the cost become excessive; and, of course, the efficiency of the turbine is somewhat impaired by the use of such extravagant dimensions in proportion to the power realized.

It will be news to the marine engineering world, and extremely interesting news at that, that Mr. Parsons says there is a way out of the difficulty, by which there can be obtained in a low-speed turbine the full measure of expansion essential to economy—an economy better than that of the best set of tramp engines of which he knows. He has found it possible to build a turbine that will operate economically under very low-pressure steam, even when it is running under slow revolutions. He states that the engines of a tramp steamer expand the steam down to about 7 pounds absolute pressure, when it is discharged to the condenser. The remaining energy, represented between the pressure of 7 pounds and that of say 1½ pounds, is practically lost. The new type of turbine is able to save about 70 per cent of this wasted energy; and the additional power due to the use of this low-pressure turbine is estimated at between 15 and 20 per cent of the whole power now realized—a gain which Mr. Parsons likens to that which was obtained in the advance from the compound to the simple reciprocating engine.

In referring to the possibility of the marine gas or oil engine becoming the extensive competitor of the steam engine, Mr. Parsons holds the same view which we have frequently expressed in this journal, that although such engines have realized a horse-power on a consumption from half to two-thirds of that of the best condensing steam engine, "it cannot yet be said that they can generally subsist on ordinary bunker coal. If, in the future, some form of gas producer using ordinary coal is successfully applied for use on board ship, and if the mechanical details of reversing can be satisfactorily arranged, then the steam engine or steam turbine will have to give place to the gas engine." That is exactly where we stand to-day, and as soon as our inventors and engineers can build a gas-producer that can take the ordinary "run of the mine," the application of the gas engine will become general in almost every branch of engineering. We do not know of a field of investigation or invention that holds out a richer prize than this.

THREE MONTHS OF RAILROAD SLAUGHTER.

The death roll of the railroads of this country continues to lengthen, and the number of casualties in any given period steadily increases. Accident Bulletin No. 13 of the Interstate Commerce Commission tells us that the number of persons killed in train accidents during the months of July, August, and September last year, as shown in reports made by the railroad companies to the commission, was 411, and that the number of injured was 3,747. Accidents of other kinds, including those sustained by employes while at work and by passengers in getting on and off cars, etc., brought the total number of casualties for that quarter of the year up to 14,239, of which 1,032 were killed, and 13,207 were injured. These figures mean that in the course of a single year, were this rate of maiming and killing sustained, our railroad system would be directly or indirectly accountable for the death of 4,128, and the more or less serious injury of 52,828 people. The Bulletin of the Commission says that the quarter under review may, as a whole, be termed the most disastrous on record. Of the 228 passengers and 183 employes killed in train accidents, 217 cases are accounted for by six accidents, and these 217 were nearly all passengers. In one case of derailment, 88 people were killed. In one collision 63 were killed; in another, 24; and two other collisions accounted respectively for 18 and 16 deaths.

The true measure of the blameworthiness of the railroad systems, in this matter of injury and death, is not so much the total number of victims as it is the total number of accidents. There is no strict relation between the number of people killed in a particular accident and the amount of carelessness, or poor management, or neglect, that brought about that particular accident. A very slight defect, not easily detected, might result in the killing of a hundred people, whereas some glaring instance of neglect might cause an accident in which the casualties were extremely small. Therefore, the true test of the ability of our railroads to take proper care of the passengers who commit themselves to their care, is the list showing the total number of accidents in a given period, and more particularly the total number of collisions and derailments, the one indicating faults of operation, and the other faults of construction and upkeep. Tested even on this basis, the records of these three months are very damaging to the reputation of our railroad systems. For the three months there were 1,439 collisions and 1,321 derailments, of which 232 collisions and 137 derailments affected passenger trains.

The technical journals which are devoted particularly to the affairs of the railroads, have complained of such reiterated and bald statements of the totals in the Accident Bulletins, as we have been in the habit of presenting in the columns of the SCIENTIFIC AMERICAN. It is claimed that careful analysis of these returns would show that the condition of affairs is not nearly so bad as the simple statement of these figures would seem to imply. It is further objected that the frequent reference we have made to the fact that in a recent year the railroads of Great Britain were operated without the loss of the life of a single passenger is also misleading, for the reason that while it may be literally true, there are unrecorded considerations which considerably mitigate the force of the comparison. We have carefully read these articles, with an honest endeavor to see the drift of the arguments set forth; but we have to confess that we have found nothing to lessen the significance of the fact that, while we have been killing people at a rate which has risen for one quarter to over 4,000 a year, a great railroad system in another country, on which the traffic is far more dense, and therefore more difficult to handle than ours, was actually able to prosecute that traffic, day in and day out, without the loss of a single passenger.

There are several conditions peculiar to American railroads which account for our large casualty list. The chief among these, undoubtedly, is the inherent restlessness of a not inconsiderable section of our railroad employes, which shows itself in the chronic disposition to move on and try some new field of work. This results in a continual change of the personnel, with the result that at any given time, on any given road, there will be found a large number of employes who are entirely new to, or but little familiar with, the special local conditions surrounding their work. Now, it is this familiarity with the local conditions, over and above the general knowledge which any engineer, conductor, brakeman, signalman, switchman, must have of his duties in the abstract—it is this familiarity we say, that is the very best safeguard against railroad accidents, or at least against those that have to do with the running of the trains.

Second only in importance as a contributory cause to railroad accidents is the continual change which is taking place in the management and official staff of our railroads, and in their ownership. As a result of the mad whirl of organization and reorganization, combinations, receiverships, and what not, there is a continual change of management from president to roadmaster. Well-established organizations and systems of management, that have gained that smoothness and accuracy of working and that mutual confidence and sense of interdependence, which can only come from long and successful association in the operation of a particular system, are suddenly broken up by the sale of the road or its combination with some other system; new men are introduced into high offices; and they, in turn, have their own particular friends or well-tried assistants whom they naturally wish to introduce; heart-burnings, jealousies, and disappointments ensue; and the whole operative system of the road is shaken from summit to foundation; for the general unrest invariably distributes itself throughout the whole working force of the road, with a consequent lowering of discipline and more or less careless performance of duties.

If the time shall ever come when the various railroads will be content to recognize each other's spheres of influence and control; if a day is ever reached when this perpetual reorganization, this turning upside down of railroad management, shall cease, we may look for a return of that sense of stability and permanence which formerly made the average period of employment by any particular company much longer than it is to-day. Then, only, will there be a return of that personal interest and pride in one's work, and that sense of security as regards the permanence of one's job, which will do more than anything else to promote careful work, whether in the construction, the maintenance, or the operation of our steam railroads. Then, and not till then, shall we see a diminution in the disgraceful record of deaths and injuries which appears with painful regularity in the reports of the Interstate Commerce Commission.

FUTURE WATER SUPPLY OF NEW YORK CITY.

If anyone doubt the possibility of New York city's having to face a water famine within the next two or three years, he should read the report recently made to the Mayor of this city by the Commission on Additional Water Supply, from which he will learn that the average rate of consumption of Croton water during the past year has exceeded the amount which all of the present reservoirs in the Croton watershed, together with the great reservoir now being formed above the new Croton dam, can supply in a year of small rainfall. This emergency has been obscured by the fact that the rainfall and stream flow for the past two or three years have been larger than the average, as shown by the records of the Croton reservoir flow, which have been carefully kept for many years. No one can predict the year of the next severe drought; but the facts that the rainfall has been above the average for the past few years, and that periods of large and small rainfall follow in cycles, make it very likely that we shall have to face some years of small rainfall in the near future. Emergency work is being done in the Croton watershed by the construction, which is immediately to be undertaken, of two dams above the new Croton dam, which together will impound an additional twenty billion gallons, to be held in reserve against a dry season; but it will take at least two years and probably longer to complete these. That we are running perilously close to the margin is shown by the following figures: During the quarter ending September 30, 1904, the average daily use of water from the Croton basin was 290 million gallons, whereas the records show that the average annual daily fall of the Croton River fell to 209 million gallons in 1880, and to 222 million gallons in 1883.

Admitting then, as we must, that it is necessary at once, and with all speed, to provide additional water supply, the question becomes one of where to get it, how to store it, and how best to conduct it to the city. These are questions of engineering pure and simple, and as such they should be judged and determined. But, alas! there has fallen upon this problem, as upon every other big engineering question affecting the interests of this city, the pernicious blight of politics. The problem is so vast, it involves such big expenditures of money, such possibilities of patronage, to say nothing of "graft," that the political harpy is watching it with a hungry eye. The Ramapo scandal is fresh in the public memory; but the snake though scotched is not yet killed. The air is full of propositions, from Engineer Birdsall's $90,000,000 tunnel aqueduct to the ex-governor's bill for State control of water rights. Meanwhile, the population of New York is growing by leaps and bounds, water consumption is increasing, and nothing is being done to adequately meet the crisis.

The agitation of this question is much older than the general public might suppose; for as far back as the year 1886, a study of the problem was made by Mr. R. D. A. Parrott, who pointed out the advantages presented by the Esopus and Schoharie creeks as a future source of water supply for this city. The results of his investigation were published in the SCIENTIFIC AMERICAN SUPPLEMENT of September 4, 1886; and it is an interesting fact that the scheme outlined at that time is practically identical, as far as the location of the reservoirs is concerned, with the Ashokan reservoir suggested by Mr. Birdsall, the present Acting Chief Engineer of the Department of Water Supply, Gas, and Electricity, and indorsed, after very considerable modifications, by the Burr-Freeman Commission in the report above referred to.

The report of the Chief Engineer calls for the construction of a dam across Esopus Creek, near Olive Bridge, and of a deep-tunnel aqueduct, 97 miles in length, from the dam to New York city. The magnitude of this part of the work will be realized more clearly when we bear in mind that the total length of

deep-tunnel construction of the present new Croton aqueduct is 29.85 miles, or less than one-third that called for in the Chief Engineer's plans. In detail, the plan proposed is to construct a single deep tunnel from Astoria, under the East River, to a point in Morrisania, whence there would be two deep tunnels to Rye Pond in the Bronx basin, a distance of 23 miles from Astoria, the two tunnels to be each 10 feet 6 inches circular aqueducts. Rye Pond reservoir, when full, would be 355 feet above mean tide. From this reservoir the plan calls for a single deep-tunnel aqueduct, 12 feet in diameter, extending by way of the east branch reservoir in the Croton basin to a point west of North Paterson, and thence due west to the Hudson River, and northwesterly to the Olive Bridge dam on Esopus Creek, which would have an elevation above mean tide of 555 feet. This 97 miles of deep aqueduct tunnel is expected to deliver 300 million gallons of water per day at an elevation of 300 feet above sea level at the Rye Pond reservoir to the north of the city limits, from which it would be led to Astoria as explained above. The cost of this deep tunnel is estimated at $500,000 per mile, and the total cost of the completed work would be over $90,000,000.

This briefly describes the first instalment of the future additional water supply. The report contemplates the construction of another aqueduct of equal capacity and probably greater length, which is to be constructed subsequently whenever it may be needed, to deliver 300,000,000 gallons of water from Catskill River at the same elevation at the city limit. The report further proposes that ultimately a third aqueduct of about the same length as the latter would be constructed, and draw yet another 300 million gallons a day from the lower waters of both the Catskill and Esopus creeks, this water to be delivered into Jerome Park reservoir. Although no estimate of the cost of the two latter additions is given, they may be presumed to equal that of the first reservoir and aqueduct; in which case the ultimate cost of the three aqueducts and reservoirs may be set down as about $275,000,000. For this sum a total of 900,000,000 gallons per day, it is estimated, could be furnished from these regions. This is about three times the present consumption of New York city.

The Burr-Freeman Commission reports to the Mayor that it concurs with Mr. Birdsall in the opinion that the waters of Esopus Creek are exceptionally pure and soft, and constitute an almost ideal source for public supply. They consider that the storage volume of the Ashokan reservoir would reach 66 billion gallons, which is more than double the addition which has been made to our present supply by the construction of the new Croton dam. Strong objection is made to the construction of a 97-mile deep-tunnel aqueduct. It is true that this method was adopted, in the case of the new Croton aqueduct, in order to render it safe against destruction by malicious persons or by a public enemy; but it is held that considerations of this character have lost their force at the present time, as the introduction of a small quantity of high explosive through a shaft, or otherwise, might easily damage a deep tunnel so that, because of its inaccessibility, its repair might be a question of many months. For this reason, and because it may be so much more quickly and easily constructed, the Burr-Freeman Commission recommends a surface aqueduct, built by the cut-and-cover method. The accessibility of such an aqueduct renders repairs easily and quickly made; moreover, as years of experience have shown, the liability to malicious injury is very remote. The capacity of the proposed deep tunnel is 300,000,000 gallons per day; but the conveniences for cleaning and repairs are such to-day that there is no reason, in the opinion of the Commission, why the cut-and-cover aqueduct should not be built, if so required, to have a capacity of 500,000,000 gallons per day.

The Commission is further of the opinion that it is not desirable to build a tunnel costing four or five million dollars, for the purpose of leading the water of Schoharie Creek into the new reservoir, but prefers instead to construct a pipe line from a dam built on Rondout Creek, and bringing an additional supply from that stream. Furthermore, instead of taking the water from a point at the center of the proposed Ashokan reservoir, the Commission would take the water from the lower end of the reservoir, so as to permit of a thorough circulation, and would build a cut-and-cover aqueduct to a reservoir known as the Hill View reservoir, located on the high ground between Yonkers and Mt. Vernon. The total length of this aqueduct would be 81 miles, a saving of 10 miles over the Birdsall line. The aqueduct proposed by the Commission would, however, connect with the new aqueduct at the Croton reservoir; and as the present total aqueduct capacity between Croton Lake and New York city is at least 75,000,000 gallons daily greater than the safe yield of the Croton watershed, including its proposed additional reservoirs, it would be necessary to build the Ashokan aqueduct for the present only as far as the Croton reservoir, and utilize the existing aqueducts, from that point to the city, to their full capacity. By adopting this plan it would be necessary to construct at once only 58 miles of aqueduct, comprising about 18 miles of steel tube, 5 miles of tunnel, and 35 miles of cut-and-cover aqueduct. After a careful review of precedents and circumstances, the Commission estimates that this work could be constructed in not less than from five to eight years, according to the conditions encountered.

As matters now stand, the Mayor is seeking the needed legislative authority at Albany for pushing through the scheme as outlined by his Commission. Meanwhile the late Governor, Mr. Odell, professes to have discovered that it will be to the interests of all concerned if the question of water supply were placed entirely in the hands of the State; and so this most vital of all questions affecting the health, and we might say the very existence of the people of New York city, must needs wait, for the present at least, upon the exigencies of party politics.

THE HEATON AIRSHIP FAILURE.

BY ENOS BROWN.

Heaton's airship, the "California Messenger," was driven into San Francisco Bay February 12. The aeronaut had a narrow escape from drowning. When the airship was taken out for a trial on the morning of February 12 across the bay in Oakland, it was cold but clear and there was a slight north wind. This wind increased rapidly, however, and when the airship was fairly well up it appeared to strike a current of air of great velocity, for despite the rudder it was driven rapidly toward the bay. The aeronaut tried to steer it south of Oakland, but the airship was driven steadily across the mud flats and then over the bay.

The wind had created a heavy sea and the airship began to sink, so that the aeronaut was in a dangerous position. Apparently some gas escaped from the compartments at one end of the machine, and as the ship sank, one end went down while the other, fully distended, stood nearly perpendicular above the waves. The aeronaut's predicament was seen by several yachts, which at once went to his rescue. He was taken off, and the airship was towed back to Oakland.

The Heaton airship consists first of a silk gas reservoir 76 feet long and 14 feet in diameter, with a capacity of 10,000 cubic feet of hydrogen gas, of a lifting power of 600 pounds. Directly beneath the bag is a sheet of canvas, denominated by the inventor an "aeroplane," designed to assist the movement of the airship in falling or ascending. The rudder is lightly constructed of bamboo covered with sacking, and is governed by ropes at the will of the engineer, the air current, generated by the rapid revolution of engine and propeller, assisting in the prompt control of the airship in the line of direction as the operator determines. The platform upon which the operator stands is built of bamboo rods trussed to the net above by linen lines.

The engine is a marvel of design and lightness in construction. Though generating 20 horse-power, the weight, exclusive of propeller, is but 55 pounds. It is described as a double-cylinder, 4 by 4, revolving around a stationary crankshaft, the propeller blades being attached to and a part of said cylinders. It is constructed of steel, and the motive power is furnished by gasoline. Power is increased by the elimination of flywheels, as well as lightness by dispensing with water coolers, the cylinders being kept cool by the strong air currents generated by the rapid motion in revolving. The two fans have each a surface of 8 square feet, and are 5 feet from tip to tip.

THE MOORE-HESKETT DIRECT PROCESS FOR THE MANUFACTURE OF WROUGHT IRON AND STEEL.

The Moore-Heskett process, of which mention has already been made in these columns, is designed for the treatment of iron sands, or pulverized concentrated iron ore in a fine state of division.

The apparatus consists of an upper and a lower brick-lined revolving cylinder attached to a gas furnace. The cylinders are lined with fire bricks, and have several brick shelves running along their whole length. They are placed at an angle of about 10 per cent from the horizontal, and revolve slowly. The finely-divided ore is automatically fed into the upper cylinder, and is continuously being lifted up by the shelves, and made to fall in a fine spray as it travels to the lower end. The inside of the cylinder is maintained at a low red heat by waste gases passing through it from the gas furnace to the chimney. The heated particles of ore, as they are delivered from the lower end of the upper cylinder, fall into a lower cylinder through a vertical flue, and are delivered into the upper end of the lower cylinder at a red heat. The lower cylinder is connected at its upper end to a gas producer or retort, and is the channel through which the reducing gas is delivered to the gas furnace. The vertical flue between the two cylinders is so arranged that the sand can enter the lower cylinder, but the gases cannot enter the upper cylinder. As the fine red-hot particles of ore travel through the lower cylinder, they are constantly being lifted up and made to fall through the reducing gases in the same way as in the upper cylinder, and are delivered at the lower end in a continuous stream, falling into the bath of the gas furnace below, where the deoxidized sand is melted as fast as it accumulates.

The gas furnace both for steel and wrought iron is made to revolve, and digest and deliver its product automatically.

The essential feature of the process is that iron ore in a finely-pulverized state is heated, deoxidized, and melted particle by particle, which enables the various operations to be carried on rapidly and continuously in one furnace, without loss of heat, and requiring practically no labor. The whole process can be carried out automatically from the ore to the fluid steel. Each separate particle of ore is made to fall a great number of times through the heating and deoxidizing atmosphere, kept at a suitable temperature below its fusing point. Under these conditions heating and deoxidation take place in a few minutes. The reduced ore then falls directly into a bath of molten metal, which is maintained at a very high temperature. As the reduced ore is gradually and constantly falling into the bath, and at a red heat itself, it is not difficult to keep up the temperature of the furnace and bath with a minimum of fuel.

The revolving cylinders of the feeding apparatus may be stopped at any time, in order to add any alloy and test samples before tapping.

In working, only a proportion, say half, of the metal is tapped out at any time, the bath being maintained constantly.

The hearth is lined with the most refractory basic material known, and should last for many months.

An excess of gas is passed through the deoxidizing cylinder; the balance not taken up by the iron ore follows the reduced ore into the furnace, and being highly combustible combines with the heated air. This arrangement insures thorough deoxidation in the cylinder and also prevents any possibility of reoxidation taking place, as the gas passes over the reduced ore in the bath, before combustion takes place, and effectually prevents any waste of gas, as complete combustion is obtained in the furnace, and the resulting products pass into regenerators for heating the air and afterward the ore-heating revolving cylinder.

THE CURRENT SUPPLEMENT.

Emile Guarini opens the current SUPPLEMENT, No. 1521, with an article on wireless telegraphy experiments at the Eiffel tower. Some interesting statistics are given of telephones and telegraphs in the United States. Mr. Frank Koester gives some practical data on European practice with steam turbines. The ore concentration plant exhibited at St. Louis, which has already been made the subject of some discussion in the SUPPLEMENT, is described in full. Mr. Philip Bjorling writes on pumps—machines that are much neglected. The Matitsch lace-making machine, a combination of the bobbinette and the English twist-lace machine, is fully described and illustrated. Sir John Eliot writes on meteorology in the British empire. Mr. J. A. Formoy recently lectured most instructively before the English Camera Club on "Suns: Their Various Stages of Development as Revealed by the Spectroscope." His lecture is abstracted. Prof. N. Monroe Hopkins presents his seventh paper on "Experimental Electrochemistry." The subjects treated in this installment are the following: Energy Required in Electrolysis, Practical Formula for Computing, Electrolytic Separation of Metals, the Rotating Anode in Electro-Analysis.

EXPLOSION OF A SUBMARINE.

On February 16 an explosion occurred on board the British submarine torpedo boat A5, resulting in the death of the commander and two of the crew and the disabling of fifteen men. From all accounts, it seems that the crew was engaged in filling the liquid fuel tanks of the vessel, and that the vapors from the gasoline became ignited. The explosion was terrific. Men were hurled in every direction, nine being afterward picked out of the water. A rescuing party sent from a nearby gunboat had hardly reached the scene of the accident when a second explosion occurred, which resulted in the injury of some of the rescuers. The submarine caught fire internally. When docked soon after, she was found to be not materially damaged.

THE CHARCOT ANTARCTIC EXPEDITION.

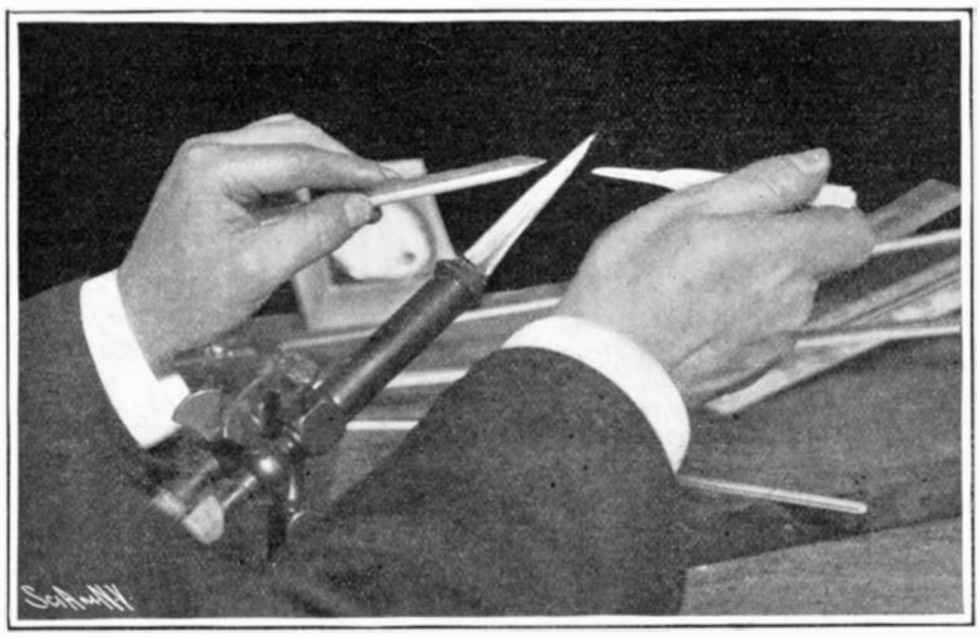
Much concern is felt for the fate of Dr. Charcot, who is leading an Antarctic expedition, which started more than a year ago.

It is known to have encountered a terrible storm in April last year and has not been heard of since, nor have any traces of its movements been discovered by Uruguay, which sent out a party to its rescue. M. Charles Rabot, a member of the committee of the Society of Geography of Paris, intends to organize another search party to ascertain its fate.

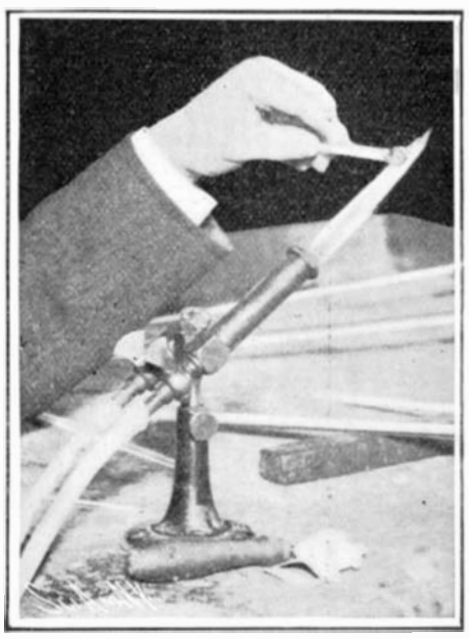
Dr. Charcot is the son of the famous nerve specialist, who was chief physician at the Salpêtrière Hospital.

HOW TO MAKE A MERCURY THERMOMETER.

The first thing to be considered in the making of a thermometer is the character of the glass to be used. The thermometer maker always selects a length of annealed glass, so hard that it melts with readiness only in the blowpipe, and absolutely uniform in bore. The length of glass is held in the blowpipe at the point where it is to be severed until it becomes so thoroughly plastic in the flame that it almost drops apart. When the glass has been thus softened it is withdrawn from the flame, grasped at each end, and quickly pulled apart. The result is two tubes, sealed at one end.



Melting the Glass and Drawing It Apart.

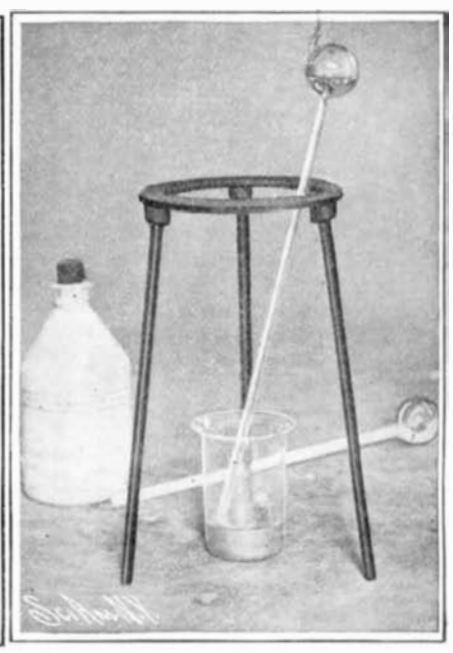


Heating the End Before Blowing.

The next step is the formation of the bulb. One of the two tubes obtained by the process just described is held in the blowpipe, the sealed end being subjected to the heat. When the glass has been melted sufficiently, the tube is removed from the blowpipe. By blowing through the open end, a bulb of any size can be formed.

After the End Has Been Heated in the Blowpipe the Bulb is Blown.

Creating a Vacuum by Boiling Mercury in the Bulb.



Immersing the Tube in Mercury so That the Metal Rushes Up to Fill the Vacuum.

After the bulb has been blown, the next step is the filling of the tube with mercury. To effect this, the open end is plunged in a vessel of mercury. The liquid metal rises slightly in the tube. The tube is then reversed, so that the mercury runs down into the bulb. By heating the bulb in an alcohol flame or Bunsen burner, the mercury is made to boil. The vapors given off drive out the air, thereby creating a vacuum. When this point has been reached, the open end of the tube is plunged into mercury, which in order to fill the vacuum, rushes up and completely fills the tube. The open end is now closed with sealing wax in order to prevent the entrance of air. Hermetic sealing is effected by holding the tube in the blowpipe beyond the wax-plugged open end, by drawing the molten end off.

Two fixed points must now be taken. The lower is usually taken first. The thermometer is placed vertically in finely-pounded melting ice, or preferably snow, contained in a vessel which will allow the water to drain away. The whole of the mercurial column should be immersed in the ice. After from twenty minutes to half an hour the thermometer may be raised until the top of the mercury is seen just sufficiently for its position to be noted. This is the freezing point—32 deg. on the Fahrenheit thermometer, 0 deg. on the Centigrade.

The temperature of water boiling is the higher fixed point. To determine this the tube of mercury is held in the steam of boiling water, which can be done by running the tube through a cork and suspending it by a wire or other means in the vapor. As the boiling point depends upon the pressure of the atmosphere, the height of the barometer must now be taken. If it stands at 760 millimeters, the temperature is 100 deg. C. If not, a calculation will be necessary; 1 deg. C. or 1.71 deg. F. must be added or subtracted for every 26.7 millimeters above or below 760 millimeters. The interval between the two fixed points is then divided into 100 parts or degrees for a Centigrade, or 212 parts for a Fahrenheit thermometer. To graduate the scale above 100 deg. a column of mercury is measured below that point, then made to pass above step by step; the portions of the tube filled by the column are then divided into the number of degrees which it represents.

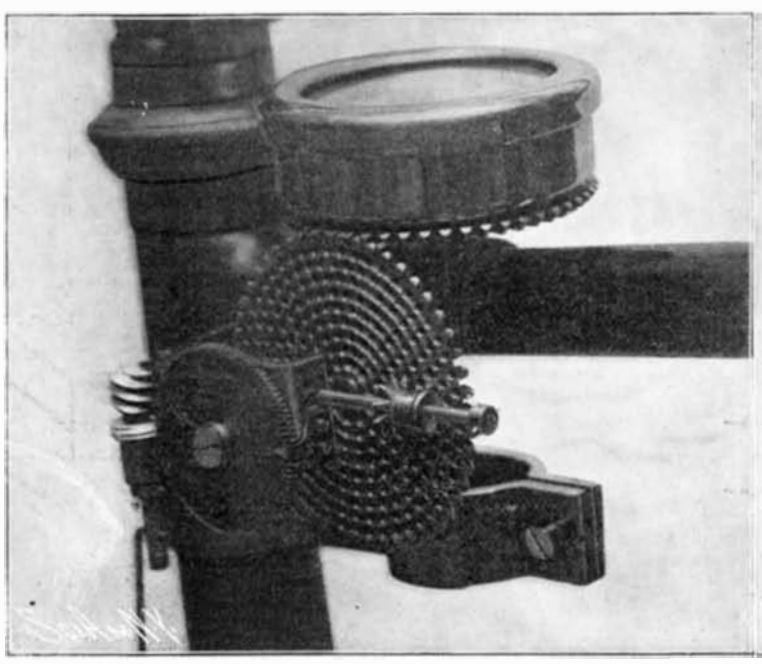
A thermometer made in the manner described is not an absolutely scientific heat-recording instrument. Still, it will be found sufficiently accurate for use in ordinary life.

A TACHOMETRIC WATCH FOR BICYCLES AND OTHER VEHICLES.

BY EMILE GUARINI.

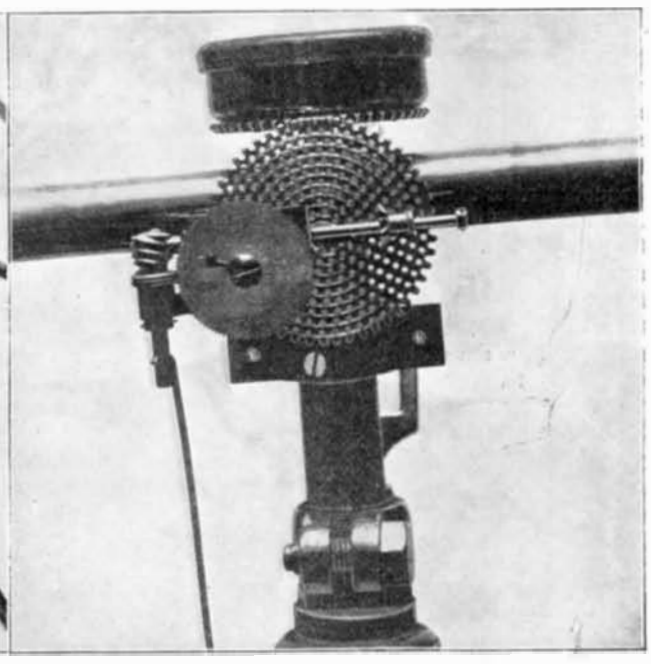
The principle of the tachometric watch, illustrated herewith, is very interesting and very simple. It consists in causing the case of a watch to be revolved by the wheel of a vehicle in a direction contrary to that of the hand of the watch and at the same rate of speed.

(*Continued on page* 162.)



Tachometer Attached to Steering Head Below the Top Bar of Frame.

View Showing the Complete Apparatus Applied to a Bicycle.



Tachometric Watch Shown Mounted Upon the Post of Handle-Bar.

A TACHOMETER FOR SHOWING THE SPEED OF VEHICLES.

A BLAST OF DYNAMITE AND HOW IT WAS PHOTOGRAPHED.

BY ARTHUR INKERSLEY.

Though giant powder is frequently used to remove rocks, tree stumps, and other obstacles to cultivation or construction, it is not an easy thing to get a satisfactory photograph showing the actual explosion of a blast. The photographer must be near enough to the center of activity to secure a detailed picture; he must watch the progress of the explosion, and expose the plate at just the right instant; and, besides all this, he must be able to save himself and his camera from the stones and débris flying through the air.

The photograph here reproduced was made in a little town named Stirling City, in California. The blast was designed to remove a stump in the roadway. The camera was set up in a partly-finished house about twenty-five yards from the stump. When the fuses were lighted, the photographer stood with one hand on the bulb and the other holding the tripod head. After exposing the plate in the camera, he retired behind the walls, dragging his photographic apparatus with him. A moment later the stones and dirt that had been thrown up into the air came rattling down upon the house, some even coming through the window from which the picture had been made. The resulting picture is certainly a successful one, being clear in detail and filling the plate satisfactorily.

PHOTOGRAPH OF A BLAST OF DYNAMITE.

NEW 25-KNOT BRITISH SCOUTS.

The spirited picture of the new British scout "Sentinel," herewith shown, represents one of a class of eight vessels which have been designed solely to do scouting work. They carry only sufficient armament to drive off or destroy an enemy's torpedo boats or destroyers. Should this vessel meet with a hostile cruiser, it would not attempt to fight, but would instantly turn and run; or cruise in the offing out of gunshot range, but keeping in touch with and observing the enemy. The prime requisites for a vessel of this class are that it shall be very fast, faster, indeed, than any protected or armored cruiser; that it shall be of sufficient size and power to maintain its speed in heavy weather; that, compatible with the preceding requirements, it must be as small and inconspicuous as possible; and that it must be thoroughly staunch and seaworthy. Its armament need only be heavy enough to defeat any craft such as a destroyer or torpedo boat that is fast enough to overtake it; and it need carry but a moderate coal supply, its sphere of action being always within easy steaming of the main fighting fleet and its attendant colliers.

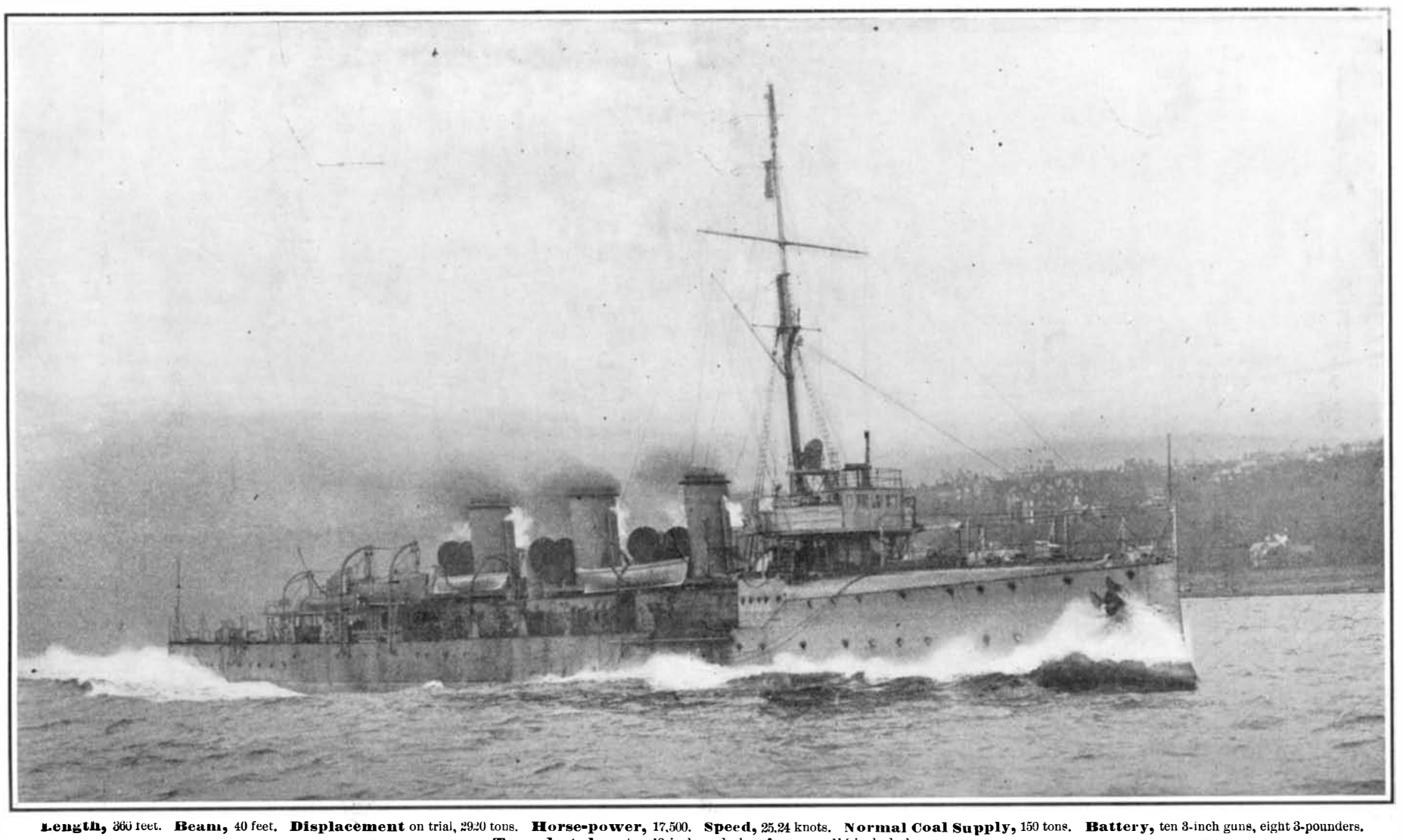
These vessels were laid down a few years ago in accordance with the modern policy of the British navy, which is to reduce the larger ships of the navy to three distinct types—the battleship, the armored cruiser, and the fast scout. The battleship will form the nucleus and the main fighting element of the fleet. Spread out fanwise beyond them will be the fast armored cruisers of 23 to 24 knots speed, and beyond these in a wider circle will stretch the scouts of 25 knots speed. Hitherto the extreme outpost duty or duties of reconnaissance have been performed by cruisers of large dimensions, 6,000 to 10,000 tons displacement or more. But the number of large vessels is limited by their great cost; and it was realized that by reducing the size, raising the speed, and trebling the number of vessels, the work of reconnaissance would be carried out over a far wider area, and by units that were in closer touch with one another and with the main body of the fleet.

Both the United States and Great Britain are building vessels of this type, or rather the British have built, and we are about to build them. In our issue of February 11 we illustrated the scouts designed for our navy, and a comparison of the two designs will be found very interesting. It will be seen from the accompanying table of dimensions that the British ship is smaller, faster, carries much less coal, and is considerably less conspicuous than our vessels. This is probably accounted for by the fact that our scouts are intended to act, if need be, on isolated duty, which may involve steaming over long distances, where there would be no access either to a collier or the coal pile.

The "Sentinel" is a vessel 360 feet in length and 40 feet in beam, displacing 2,920 tons. She has a high forecastle, to enable her to meet heavy seas, but otherwise she lies low in the water; her smokestacks are unusually short, and she is very inconspicuous—a valuable feature in scouting. She is provided with a single signaling mast, and indeed, in respect of her appearance, is merely a magnified torpedo-boat destroyer, her displacement being about seven or eight times greater than one of these craft. The steam trials prescribed by the Admiralty were that the vessel should steam for ninety-six hours at cruising speed, and that the rate of coal consumption on the latter half of this run should determine the quantity of fuel that the vessel was to carry when running at full power on her trial trip. She was to have sufficient fuel on board to enable her to steam at cruising speed for 1,500 miles; and with

COMPARISON OF BRITISH AND AMERICAN SCOUTS.

	British.	American.
Length, feet	360	420
Beam, feet	40	46⅔
Displacement, tons	2,920	3,750
Horse-power	17,500	16,000
Speed, knots	25.24	24
Normal coal supply, tons	150	500
Armament	Ten 3-inch, eight 3-pounders	3-inch
Torpedoes	Two 18-inch	inch
Freeboard, forward	24 feet	
Freeboard, aft	14 feet	



Length, 360 feet. **Beam,** 40 feet. **Displacement** on trial, 2920 tons. **Horse-power,** 17,500. **Speed,** 25.24 knots. **Normal Coal Supply,** 150 tons. **Battery,** ten 3-inch guns, eight 3-pounders. **Torpedo tubes,** two 18-inch on deck. **Armor,** 1½-inch deck.

The eight vessels of this class are intended for the same duties as the new United States scouts, illustrated in our issue of February 11, with which they may be compared.

NEW 25¼-KNOT BRITISH SCOUT "SENTINEL," FASTEST CRUISER AFLOAT.

this allowance of coal, and a load equivalent to the prescribed weight of ammunition, guns, etc., the vessel was required to steam continuously for eight hours, at a speed of 25 knots an hour. In the cruising speed trials it was found that one ton of coal was sufficient to carry the ship for 11 sea miles. On the eight hours' full-power trial, the engines worked up to a collective indicated horse-power of 17,500, and the mean speed for the whole run of 202 knots was 25.24 knots per hour. Incidentally, it may be mentioned that the load thus propelled is more than five times the average weight of a freight train making about the same speed on the rails.

As a measure of the cost of high power, it may be mentioned that the records of the trial show that to increase the speed from 22½ knots to 25 knots involved doubling the power required for the former speed. And further, that the last knot, that is the advance from 24 to 25 knots, involved a quarter of the maximum power, or an addition of over 4,000 horse-power, which, by the way, proved sufficient to drive the vessel at 19 knots an hour.

As showing how largely the great increase in horse-power and speed of modern warships has contributed to their cost, it may be mentioned that during the course of the trials, the new scout steamed around one of the armored cruisers of sixteen years ago, which was being taken under tow to her moorings, where she is to lie as an obsolete ship until she is sold. This cruiser of sixteen years' standing cost only about 25 per cent more than the modern vessel, although she has a displacement tonnage three times as great as that of the "Sentinel." In the case of the cruiser, the proportion of power to tonnage is barely 1 horse-power to 1 ton; whereas the "Sentinel" has 5¾ horse-power per ton; and consequently, her cost per ton is very much greater than that of the older but larger ship.

MY SCIENTIFIC EDUCATION.

BY THE RT. HON. LORD KELVIN.

I am a child of the University of Glasgow. I lived in it sixty-seven years (1832 to 1899). But my veneration for the ancient Scottish University, then practically the University for Ulster, began earlier than that happy part of my life. My father, born in County Down, was for four years (1810 to 1814) a student of the University of Glasgow, and in his Irish home, as first professor of mathematics in the newly-founded Royal Belfast Academical Institution, his children were taught to venerate the University of Glasgow. One of my earliest memories of those old Belfast days is of 1829, when the joyful intelligence came that the Senate of the University of Glasgow had conferred the honorary degree of Doctor of Laws on my father. Two years later came the announcement that the Faculty of Glasgow College had elected him to the professorship of mathematics. My father's experiences as a Glasgow student are naturally of supreme interest to myself. There were no steamers, nor railways, nor motor cars in those days. Can young persons of the present time imagine life to be possible under such conditions? My father and his comrade students, chiefly aspirants for the ministry of the Presbyterian Synod of Ulster and for the medical profession in the North of Ireland, had to cross the channel twice a year in whatever sailing craft they could find to take them.

At the beginning of his fourth and last university session, 1813-14, my father and a party of fellow students, after landing at Greenock, walked thence to Glasgow. On their way they saw a prodigy—a black chimney moving rapidly beyond a field on the left-hand side of their road. They jumped the fence, ran across the field and saw to their astonishment Henry Bell's "Comet" (then not a year old) traveling on the river Clyde between Glasgow and Greenock. Their successors five years later found in David Napier's steamer "Rob Roy" (which in 1818 commenced plying regularly between Belfast and Glasgow) an easier, if a less picturesque and adventurous way between the college of Glasgow and their homes in Ireland. Those students who had experience of cross-channel passages before and after the advent of the "Rob Roy" may well have been grateful to their college, not only for what it did for themselves but for what sixty years before it did for steam navigation in giving to James Watt a scientific home and congenial friends, and a workshop in the old University territory adjoining to the High Street of Glasgow. In the course of his four student years my father attended the classes of humanity, moral philosophy, mathematics, natural philosophy, anatomy, divinity. Though his passion was for science, and especially mathematics and natural philosophy, he attended during his first three sessions and won prizes in the Latin class, then happily, as now, called humanity. It is scarcely possible to overestimate the life-long good gift presented to a scientific student one hundred years ago, as now, by universities in giving something of the *literæ humaniores* to all who can and will take it.

In 1834, two years after my father was promoted from Belfast to the Glasgow Professorship of Mathematics, I became a matriculated member of the University of Glasgow. The little tinkling bell in the top of the college tower, calling college servants and workmen to work at six in the morning; the majestic tolling of the great bell wakening at seven o'clock professors (and students, too, I believe, in the olden times, when students lived in college); then, again, the lively little tinkling bell calling the professors and students of moral philosophy and senior Greek and junior Latin at half-past seven to work in their classrooms. Woe to the student of Latin who reached the door ten seconds after the quick little bell's last stroke. He was shut out by the door-keeper, unfailingly ruthless, by inexorable order, and had to wend his way through the darkness to his lodging, sorrowfully losing the happy hour's reading of Virgil or Horace or Livy with his comrades, under their bright young professor, William Ramsay, and knowing that he had got an indelible black mark against his name. Rarely did even a single student of a large class experience this disaster. It was a sharp, healthy, beneficial discipline, rigorously maintained by one of the kindest and most considerate of all the professors who have ever guided students in the Scottish universities.

As to Latin, I followed my father's example and attended divisions of the class during three sessions. To this day I look back to William Ramsay's lectures on Roman antiquities and readings of Juvenal and Plautus as more interesting than many a good stage play that I have seen in the theater. Happy it is for myself that his name and a kindred spirit are with us still in my old friend and colleague our senior professor, George Ramsay. Greek, under Sir Daniel Sandford and Lushington, logic under Robert Buchanan, moral philosophy under William Fleming, natural philosophy and astronomy under John Pringle Nichol, chemistry under Thomas Thomson (a very advanced teacher and investigator), natural history (zoology and geology) under William Cooper, were, as I can testify by my own experience, all made interesting and valuable to the students of Glasgow University in the thirties and forties of the nineteenth century. Sandford, in teaching his junior class the Greek alphabet and a few characteristic Greek words, and the Scottish pronunciation of Greek, gave ideas and something touching on philology to very young students, which remains on their minds after the heavier grammar and syntax which followed have vanished from their knowledge. Logic was delightfully unlike the Collegium Logicum described by Goethe to the young German student through the lips of Mephistopheles. Even the dry bones of predicate and syllogism were made by Prof. Buchanan very lively for six weeks among the students of logic and rhetoric in Glasgow College sixty-seven years ago; and the delicious scholastic gibberish of *Barbara celarent* remains with them an amusing recollection. A happy and instructive illustration of the Inductive Logic was taken from Well's Theory of Dew, then twenty years old. My predecessor in the Natural Philosophy Chair, Dr. Meikleham, taught his students reverence for the great French mathematicians, Legendre, Lagrange, Laplace. His immediate successor in the teaching of the Natural Philosophy class, Dr. Nichol, added Fresnel and Fourier to this list of scientific nobles; and by his own inspiring enthusiasm for the great French school of mathematical physics, continually manifested in his experimental and theoretical teaching of the wave theory of light and of practical astronomy, he largely promoted scientific study and thorough appreciation of science in the University of Glasgow. As far back as 1818 to 1830 Thomas Thomson, the first professor of chemistry in the University of Glasgow, began the systematic teaching of practical chemistry to students, and by aid of the Faculty of Glasgow College, which gave the site and the money for the building, realized a well equipped laboratory, which preceded, I believe, by some years Liebig's famous laboratory of Giessen, and was the first of all the laboratories in the world for chemical research and the practical instruction of University students in chemistry.

In the province of the humanities the working power of the University for instruction and research has been largely augmented during the last fifty years by the foundation of new professorships, conveyancing, English language and literature, Biblical criticism, clinical surgery, clinical medicine, history (in my opinion the most important of all in the literary department), pathology, political economy. In mathematics and in the science of dead matter, professorships of naval architecture and geology; lectureships of electricity, of physics, and of physical chemistry; and demonstratorships and official assistantships in all departments have most usefully extended the range of study, and largely strengthened the working corps for research and instruction.

A plan is under consideration by Salt Lake City authorities to provide automobile street sweepers.

A TACHOMETRIC WATCH FOR BICYCLES AND OTH VEHICLES.

(*Continued from page* 160.)

The hand, then, does not budge relatively to the vehicle, and remains in an invariable position with respect to the handle bar of the bicycle, for instance, if the instrument is mounted on one of these. Since the velocity thus communicated to the case by the wheel does not vary, the rider is sure that he is moving at a constant velocity as long as the hand does not appear to have moved. If, after the hand has appeared to have moved, it is turned back to its original position, the rider is sure to have run on an average at a constant speed. This speed corresponds to the ratio of the gearing existing between the case and the wheel. The tachometric watch, therefore, supposing that it is proposed to travel at so many miles an hour, permits of gaining speed in a descent or of losing it in slowing up or stopping. If, afterward, the rider, by increasing or decreasing the speed, succeeds in bringing the hand back to its initial position with respect to the handlebar, he will be sure of having run at the mean speed corresponding to the ratio of the transmission. The hand considered is the hour one, or, generally, that of the seconds placed in the center of the dial. In this case, it is possible to read the deviations in speed to within a minute. It must be recalled, however, that the hand has lost or gained several revolutions, in order to bring it behind or before the exact number of revolutions by which it has varied. The mean speed that is obtained by keeping the hand apparently stationary depends upon the reducing ratio of the transmission. This ratio may be changed at will, without dismounting from the machine, in such a way as to cause a variation in the speed that it is desired to preserve on a gradient or on a level. With this object in view, the manufacturers, MM. Chateau et Fils, of Paris, are constructing two kinds of tachometric watches, one of them operating with a movable pinion and the other having a rubber belt for actuating the case.

The first type gives no error of transmission, since everything is done by gearing. To the axle of the front wheel of the bicycle is fixed a star-wheel, and a rod actuated by this controls an endless screw that drives a horizontal shaft having keyed to it a sharp-toothed pinion which can be slid along it. This pinion gears with a disk at different positions through apertures arranged in circles. Each circle is provided with a different number of apertures, and equal to the number of millimeters of its diameter. It is necessary, according to the circle with which the toothed wheel gears, to run with greater or less speed in order to keep the hand inoperative. Figures from 1 to 9 are marked upon a division, and the toothed wheel is arrested opposite figures corresponding to the speed in kilometers per hour, indicated opposite each figure upon a reckoning device. There can be no error except by reason of the imperfect regulation of the watch. If the latter varies 5 minutes a day, the error committed in the estimation of the speed will be 1-144, which error is therefore practically of no consequence.

The second type is more simple, but gives rise to errors due to slippage, amounting to about 0.02 at the most. The star-wheel is the same as in the other type. The watch is inclosed in a revolving case mounted on a collar which is screwed to the handlebar and is operatively connected with a drum actuated by a rubber belt passing over different channels, each of which corresponds to a determinate speed. The principle of the apparatus is the same as that of the preceding type.

Both types may be provided with a differential counter formed of two disks of 99 and 100 teeth that gear with the endless screw that actuates the case. The disks revolve in unison, and one of them is graduated from 0 to 100 and the other from 0 to 10,000. These numbers represent every twelve meters made by the wheel. A stationary index indicates up to 100 dekameters, and a movable one up to 10,000. The accuracy is within about 10 centimeters.

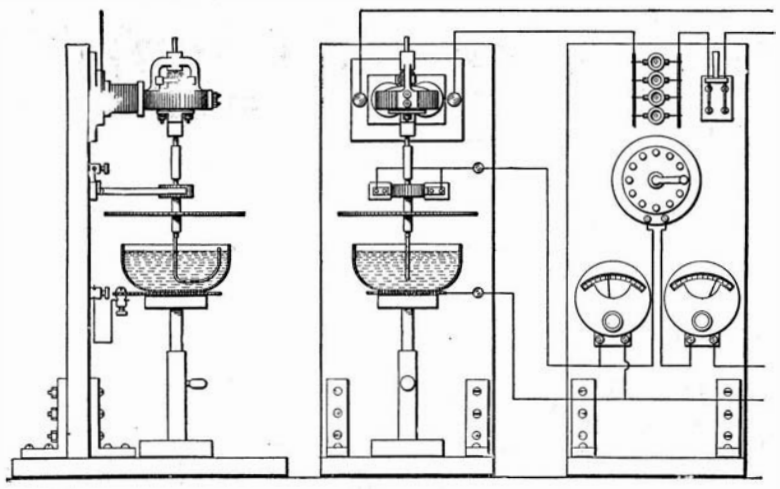
A 100-Mile Automobile Road Race in Cuba.

On the 12th instant the automobile racing invasion of Cuba was completed by the running of a 160-kilometer (99.36-mile) road race. The race was run over a fine stretch of road from Havana to San Cristobal and return, there being one neutralized stop at the turning point. On account of a collision a few days before, in which he was injured slightly and his mechanic Hawley rather seriously, E. R. Thomas was unable to compete with his 90-horse-power Mercedes. Tracy drove Major C. J. S. Miller's (formerly Mr. W. Gould Brokaw's) 30-horse-power Renault racer, and Fletcher drove an 80-horse-power De Dietrich. The race was won by Mr. E. K. Connill's 60-horse-power Mercedes, driven by Ernesto Carricaburn, a young Cuban. His time was 1 hour, 50 minutes, 53 3-5 seconds. The Renault was second in 1:52:26. This machine had trouble with the battery shaking loose, which delayed it somewhat. Otherwise, it would have undoubtedly won.

AN EASILY-CONSTRUCTED ROTATING ANODE EQUIPMENT FOR RAPID ELECTRO-ANALYSIS.

BY N. MONROE HOPKINS, PH D.

Having employed for some time past, with much success, a rotating anode for rapid electro-deposition, the construction of the equipment is deemed of sufficient interest to warrant its illustration. With such a piece of apparatus metals can be completely precipitated in a few minutes, whereas with a stationary anode it was necessary to employ such feeble electric currents that several hours were required. It may be stated that the effect of the rotating anode is to maintain a homogeneous electrolyte, by preventing concentration changes due to differential ion velocity. The construction of this outfit is exceedingly simple, as will be seen from the drawing, consisting of a vertical board firmly bolted to a heavy base by angle irons, and supporting an electric motor mounted with its shaft in a vertical position. A few words about this motor are necessary, for it will be the tendency of those making this apparatus to buy a very small battery motor, as in reality it has practically no work to do in rotating the platinum wire in the solution. A very small motor is very unsatisfactory, as it cannot be operated in connection with a lighting circuit, even by using a lamp bank. A large motor is easily controlled in speed and adjustment, and runs smoothly and without attention. Directly under the commutator, upon which copper or preferably carbon brushes feed, is a large metal disk to prevent any minute particles from falling into the solution. The platinum dish should rest upon a sheet of platinum supported on an adjustable stand, in order that the dish may be quickly lowered to remove the anode. At the extreme right in the illustration we have a panel board with the necessary electrical instruments for maintaining the proper electrical conditions for this character of work. In all reports upon electro-deposition it is necessary to state the current flow, the current density, the electrode tension, and temperature in addition to the character of the solution, etc. This illustration is taken from the author's series of articles upon "Experimental Electrochemistry," appearing bi-weekly in the SCIENTIFIC AMERICAN SUPPLEMENT, where a more detailed account of electro-analysis is given, and where those interested in this subject may turn for certain recent laboratory data.



AN EASILY-CONSTRUCTED ROTATING ANODE FOR RAPID ELECTRO-ANALYSIS.

A HUGE ELECTRO-MAGNET FOR OPTICAL AND SURGICAL WORK.

The greatly increased speed of mechanical tools which has been made possible by the introduction of the "new steel," and the resulting increase in the velocity of particles of steel which by chance may strike the eye, have caused oculists to look for electro-magnets of far greater attractive force than those heretofore constructed for this line of work. To meet this demand, at the request of Dr. F. M. Wilson, the oculist on the medical staff of the Bridgeport, Conn., General Hospital, the author of this article designed and assembled the electro-magnet illustrated herewith, which, for the use of the profession, is probably the largest magnet thus far constructed.

On account of its great weight, it was not deemed advisable to make the instrument movable, as the necessary frame would occupy more space than could be given in a physician's office. The vertical position has not been found inconvenient, however, in actual use. The iron core of the magnet is four feet long and six inches in diameter. It is bolted to a base of oak, and its upper part is tapered so as to enable the oculist to conveniently observe the patient's eye with an ophthalmoscope. The point of the tapered portion of the core unscrews, so that it may be treated antiseptically, and on this point is a brass piece carrying a small brass ring. The patient rests his face on this ring, which is of such a height that the eyelashes just touch the extremity of the conical point. The magnet requires 30 amperes at 110 volts to completely saturate the core, which is wound in two halves with 235 pounds of No. 7 B. and S. gage copper wire wrapped with a special insulation of cartridge paper in place of the usual cotton thread. The powerful lines of force of the magnet are illustrated in a measure by dropping iron filings on a piece of cardboard placed on its top. The filings build up in a pile, being held in place by the magnetic attraction as shown in one illustration. Another picture shows how stray pieces of metal can be held against a person's face when the back of his head is placed against the magnet. The third photograph illustrates the method of procedure followed in drawing a piece of steel out of one's eye. The magnet is particularly useful in diagnosing cases in which a piece of metal is thought to have become lodged in the eye, but in which the oculist is not sure of it. By placing the eye of the patient above the magnet, as shown, and sending a small current through its coils, the presence of a piece of steel will be immediately felt by the patient, because of the magnet's attraction for the steel. The magnet may be used in surgery in the same way. If a piece of steel or iron has been driven into any part of the body, its location may be determined at once by simply approaching the magnetic field. Further, if the wound is recent, the piece of metal immediately returns by the same course it entered without any surgical interference.

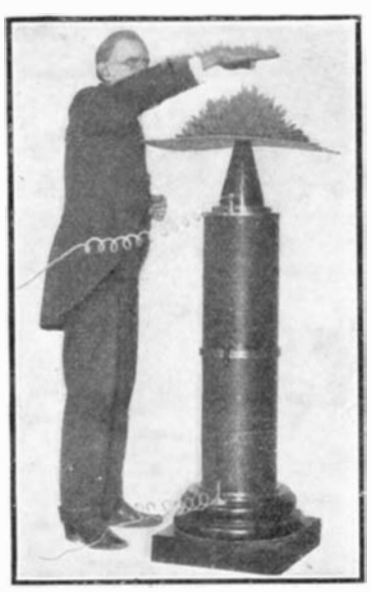
In one instance a piece of a hammer head had been driven into the muscles of the upper arm, and in another case a piece of a cold chisel into the forearm. In these two cases the surgeons advised no operations, trusting to the pieces working out of themselves; but the wounds became infected and the magnet was tried. The success of the method was complete, the pieces of metal appearing immediately on the polar piece. Possibly the operations on these were the first ever performed wherein a powerful electro-magnet had removed metallic pieces, if we except cases of the eye.

Since then, at the Bridgeport hospital, pieces of steel have been removed from the hand. In one case a chip of steel had been embedded in the palm of a man's hand for a year and a half, and in another a piece had been in the back of the hand for seven years. Both were encysted, but they immediately appeared on the magnet when the skin was slightly opened, a protuberance caused by the magnetic attraction indicating the locality.

A broken sewing needle that caused much pain and produced considerable swelling was instantly removed from the palm of a woman's hand. These cases, all of which were successful, would make it seem that powerful electro-magnets could be of great use in military hospitals for the removal of pieces of shells and steel bullets. As in the above-mentioned cases, which were of recent occurrence, the particles made their exit through the same trauma by which they entered, there would no doubt be a similar result in gunshot wounds, surgical interference with its numerous dangers thus being avoided.

Some further particulars regarding this magnet and the calculations involved in designing and building the same will be found in the current SUPPLEMENT.

Position of Patient When Removing Steel from the Eye.



Showing the Lines of Magnetic Force by Means of Iron Filings.

Pieces of Iron and Steel Held in Place by Magnetic Attraction.

A HUGE ELECTRO-MAGNET FOR OPTICAL AND SURGICAL WORK.

Fraud in Furs.

As a people we are very fond of fraud. We don't much care for law, and we love to be fooled. In no line of commerce are we more regularly fooled and defrauded than in the retail fur trade. The ermine which my lady buys for the collar of her opera coat cost her some dollars a skin. She may pay $1 for the black tip of the tail of a single ermine skin. The trapper who caught the weasel from which came the ermine got, perhaps, ten cents for the skin; perhaps five; perhaps nothing. That is not so bad, and no one could object to a commercial transaction of that kind. A great many persons know that ermine is weasel. How many know that muskrat pulled and dyed is often sold as seal; that nutria similarly treated is sold as seal or beaver; that rabbit so treated is sold as seal or electric seal; that pulled and dyed otter is regularly sold as seal; that marmot dyed is sold as mink and sable; that fitch dyed is sold as sable, and rabbit also sold as sable; that hare and muskrat are sold as mink or sable, and white rabbit as ermine or chinchilla or fox; that goat is dyed and sold as bear; that many kinds of lamb are sold as Persian; that skunk is called Alaska sable; that American sable is sold as Russian crown sable; that monkey and lynx and dog and fox and polecat and muskrat and cat, and all sorts of different furs are sold under all sorts of high-sounding names; that white hairs are regularly inserted in fox skins and sometimes in sable skins? Surely not all of our readers were advised as to these details. There is a vigilance committee appointed by the London Chamber of Commerce whose duty is to spread information against these trade frauds. We presume we need nothing of that sort in America, for here we don't mind being fooled.—Field and Stream.

Another Patent Granted to Cornelius Vanderbilt.

Letters patent have recently been granted to Cornelius Vanderbilt for an improved locomotive tender. The object of the invention is to provide a simple and economical form of water-tank with a low water-intake and large capacity, to shorten the length of the tank without increasing its height, and to improve the construction of the fuel-hood.

The water-tank is elliptical in cross-section and has its major axis in a horizontal plane. This shape was chosen because such a tank has a larger capacity than a circular one of equal height, and because its center of gravity is lower than that of a circular tank of equal capacity. To prevent the water from rushing from one end to the other on starting and stopping, a series of baffle-plates is provided extending toward the center from the top and bottom of the tank. The lower plates are provided with suitable openings for the passage of the water. The tank is interiorly braced by angle-iron stiffening members riveted to the shell and extending entirely around it. The baffle-plates are secured to these braces.

The rear wall of the coal-hood is in effect a continuation of the end of the tank. The hood is provided with side-walls, a distance apart equal to the major axis of the cross-section of the tank. The rear end has sliding doors with handles. In front of it is a platform on which the fireman may stand.

The underframing of this car consists primarily of two longitudinal draft-sills which are connected directly to the shell of the water-tank, and which have mounted between them ordinary draft-rigging.

In the earlier forms of the Laval steam turbines, a 5-horse-power motor, with a diameter of 12 centimeters, made about 30,000 revolutions per minute.

ROCKY MOUNTAIN AVALANCHES.

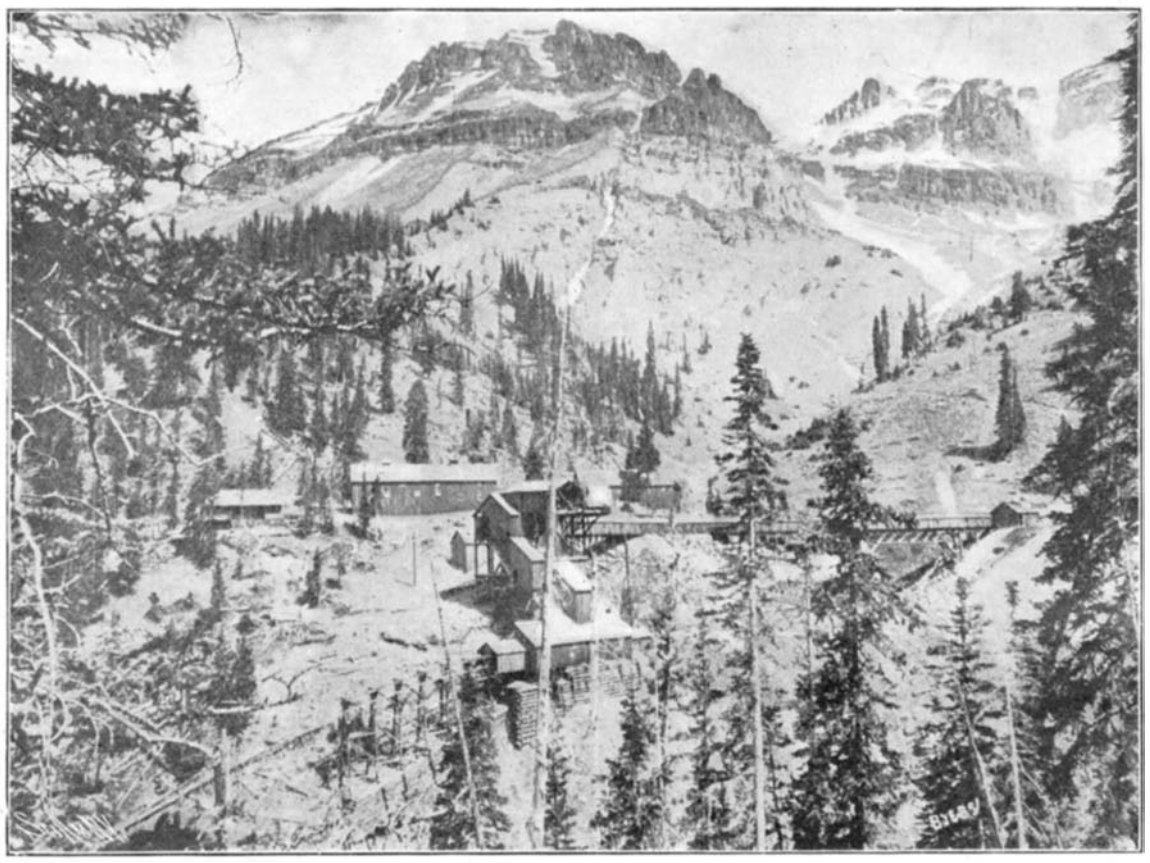
BY DAY ALLEN WILLEY.

While avalanches or snow-slides frequently occur in the Rocky Mountain region, and many of them are of great magnitude, what is known as the San Juan district in southwestern Colorado is especially notable for these movements, owing to the formation of the ranges. Several of the peaks are over 13,000 feet in height, and the conditions are especially favorable for the motion of the snow, as the mountain sides are deeply cut with gulches, which form numerous routes. Consequently, not only in winter, but during the spring, miners and others working on the slopes of the mountains are obliged to be continually on the lookout, for frequently without warning an avalanche will descend with such force as to carry with it large forest trees and bowlders, attaining such a velocity that it destroys everything in its path. Some of the avalanches have carried a bank of snow over 100 feet in depth into the valleys which they penetrate, the snow bed covering several acres.

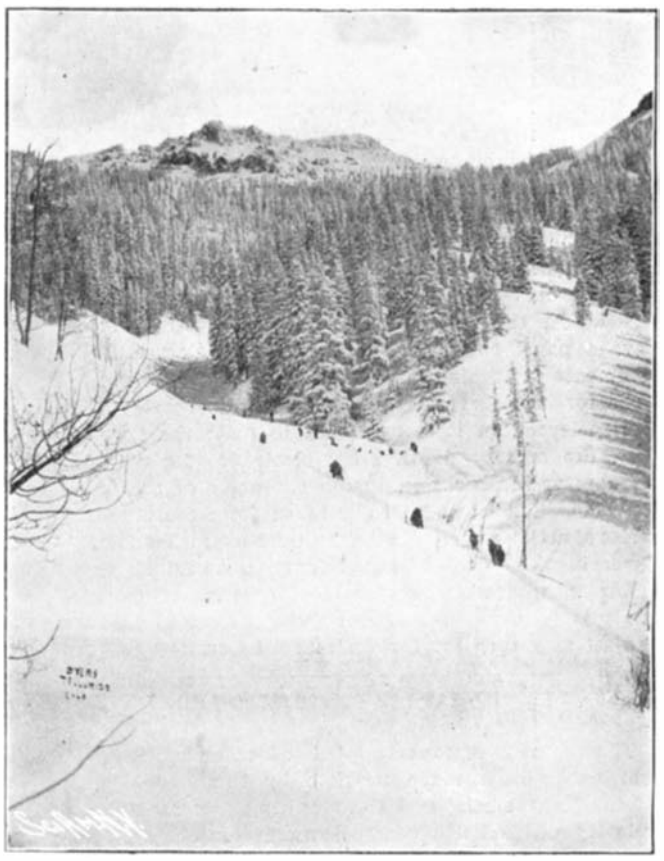
Despite the caution exercised by the people on the mountain side, many fatalities have occurred, especially in the Telluride mining district, which is located in the San Juan region. The worst disaster thus far recorded occurred when a settlement in the vicinity of the Liberty Bell mine was struck. All the buildings in the path of the avalanche were destroyed. The wing of one of the mine buildings was torn away, and two engineers were buried in the snow. A party

(*Continued on page* 166.)

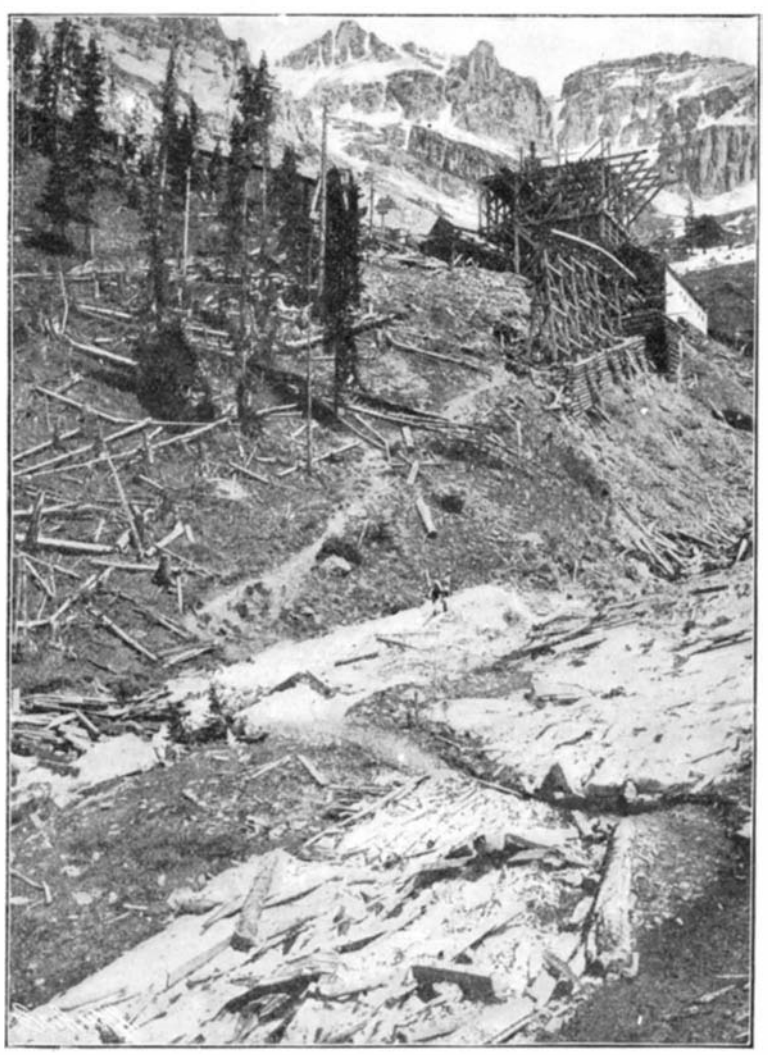
View of One of the Buildings Partly Wrecked.



Mining Plant in the Outskirts of Telluride, Colo., Where One of the Most Destructive Slides Occurred.



The Avalanche That Wrecked the Mining Shaft. At Several Points the Snow Was Over 100 Feet Deep.



How the Forest Was Denuded by the Slide.

Ruin Caused by an Avalanche at Amer, Colorado.

Scene in the Valley After the Slide.

ROCKY MOUNTAIN AVALANCHES.

ANTIQUE WATCHES OF THE FAMOUS MARFELS COLLECTION.

BY CHARLES A. BRASSLER.

Perhaps the most wonderful collection of antique watches is the property of Carl Marfels, of Berlin. It includes only handsome specimens of great artistic value which have been culled from thousands of antique pieces.

Thanks to his great perseverance, Mr. Marfels succeeded in gathering a collection unique of its kind, consisting of superb specimens of the chronometric art from its inception to the eighteenth century. True, these watches are not time-pieces of great precision. Everybody knows that precision in watches dates only from the nineteenth century. The handsome works, however, present all the perfection that could be expected of their makers, and they are in every way worthy of the wonderful and artistically-worked cases in which they are inclosed.

While great progress has been made latterly in endowing watches with remarkable accuracy, it may truly be said that the artistic skill reached in the sixteenth, seventeenth, and eighteenth centuries in the decoration of the cases, dials, and cocks cannot be excelled. Thus we meet engraved watch cases and dials from the eighteenth century which fill the art lover with boundless admiration. Enamel paintings have been preserved from the seventeenth century which could not be produced at the present time in such perfection. Think of the goldsmithing work in the watches of the seventeenth and eighteenth centuries, the precious stone embellishments, the chasing, *repoussé* work, the application of four-colored gold, the vernis Martin, filigree work.

The accompanying illustrations cannot even faintly reproduce the beauty of the originals, as they lack the gorgeous colors of the enamel and the sparkle of the precious stones which can only be indicated in black and white, nor do they give an adequate idea of the fineness of the engraved and pierced work. Still, they may serve to show the reader the high degree of perfection attained by the decorative arts in former centuries.

1.—Early cylindrical watch; 2.—Foliot and hog's bristle of cylindrical watch; 3.—A richly-worked bronze watch; 4.—Egg watch; 4*a*.—Side view of egg watch; 5.—Silver cross watch, Amsterdam, 1650; 6.—Egg watch, Amsterdam, 1650; 7.—Gold-enameled egg watch, 1600; 8.—Engraved egg watch, indicating week, date and phase of moon; 9.—Smallest of old watches (9 mm. or 0.354 inch in diameter); 10 and 10*a*.—Engraved watch made by Gamod, 1640; 11.—Watch with religious scenes, 1700; 12.—Watch set with pearls and inclosing a music box; 13.—Watch made by Albery, London, 1800; 14.—Gold box containing a bonbonnière and a wren that chirps; 15.—Tulip watch of gold, inlaid with pearls, 1800; 16.—Mandolin watch with filigree work; 17.—Rock crystal watch with engraved dial.

HISTORIC WATCHES IN THE MARFELS COLLECTION.

It is to be hoped that this beautiful collection, if it should ever be on the market, through death or otherwise, will be acquired by one of our art lovers or museums, and thus, like so many other charming works of art, ultimately come to America, where it is certain to be admired and appreciated as much as anywhere in the world.

As is well known, Peter Henlein, of Nuremberg (about 1500), is now generally credited with the invention of the portable watch, and a movement is on foot to erect a monument to the memory of this ingenious locksmith in his native city.

The earliest watches were naturally rather crude; this is shown by the few specimens still in existence (see Figs. 1 and 2). They were circular in shape (not oval or egg-shaped), and entirely made of iron. In place of the round balance we find a straight one called "foliot." Like almost all watches up to the year 1790, they were provided with the verge escapement. The hair spring is, of course, absent; it was not invented till 150 years later. In order to obtain a tolerably uniform rate an upright hog's bristle (the dot at which the arrow *a* in Fig. 2 points indicates where the bristle is situated) was used against which the foliot strikes. The uneven traction of the spring they endeavored to prevent by means of a brake. Great accuracy was not aimed at, which is shown by the fact that the oldest watches with very few exceptions up to about the year 1700, indicated only the hours, the minute hand being entirely absent.

While the first watches were rather crude, we see, only 20 or 30 years after their invention, works that may almost be termed technically perfect. The iron plates and wheels had given place to finely gilt brass ones. The pinions are of steel and polished, the cocks artistically engraved, and the pillars neatly turned.

Greater precision was obtained when about the year 1660 the hair spring was invented by Dr. Hooke (and also, but entirely independent of the latter, by Huyghens). This opened the way for the introduction of the minute hand, which we meet quite generally around the year 1700. Some of the oldest watches were already furnished with a striking mechanism. About the year 1600 there were watches with alarm made, and in 1691 Barlowe, an Englishman, introduced the repeating watch.

The invention of the fusee is also quite old. The Marfels collection contains a table clock with spring and fusee dating from 1509.

Toward the year 1800 we meet for the first time the seconds hand in verge as well as cylinder watches. The cylinder escapement is known to be quite old; for it was originated as far back as 1710, but was not generally adopted until about 1840. The lever escapement, the one used in the majority of our American watches of the present time, was invented about 1765 by Thomas Mudge. No lesser artist than Pierre le Roy is the originator of the duplex escapement, which was contrived by him already in 1748, but like the cylinder escapement was not introduced until a whole century had elapsed.

A few remarks regarding the traits by which the age of watches may be determined will doubtless prove of interest. It is now definitely known that the egg-shaped watch is not the oldest form, as was formerly supposed. They are not met with till the middle of the sixteenth century; most of them date back to the period around 1600. Enamel painting in colors was invented in 1632, hence there were no watches decorated with enamel till that time. As stated before, the balance spring was invented as far back as 1658, but only rarely employed, and did not become more general until about 1690. Watches with striking mechanism were already carried in the sixteenth century, but repeaters were not invented before 1691, and only became frequent about 1720; while alarm watches were used as far back as in 1600. The minute hand was introduced only with the use of the balance spring, hence it is not met with in watches of older construction than the close of the seventeenth century. The cylinder escapement, though invented in 1710, is only found in isolated cases in the eighteenth century; almost all pocket watches till the beginning of the nineteenth century had verge escapements. Watches with chased cases do not occur before the beginning of the eighteenth century; most of them date from the period about 1750. Decoration in four-colored gold (*quatre couleurs*) is not found before the year 1770. The gong is first used about 1800. Movable figures on the dials, figures that beat upon bells, millwheels, etc., do not occur before 1790, musical watches not till about 1800, nor were there any watches set with pearls before that period. Pocket timepieces having the form of mandolins, harps, enameled shells, tulips, flasks, balloons, finger rings, and similar objects generally fall in the period from 1800 to 1820. Pierced cases, usually decorated with foliage and animal figures, date mostly from the time 1670 to 1720. Rock-crystal cases usually date from 1550 to 1650. Watches with stone cases, agate, jasper, as well as those decorated with precious stones, generally date from the eighteenth century. The very flat cylinder watches, generally with a pin for winding, were made around 1840. The earliest watches were cylindrical in shape. From the year 1550 to 1680 they were made

flatter. With the adoption of the balance spring about 1690, the watches became very thick, almost spherical, till they were made flatter again around 1770, to reach toward the year 1800 the thickness of the present watch.

A few words respecting the value of old watches may not be amiss. Valuable are all watches whose cases and dials are artistically decorated, the essential and prime condition, however, being that the cases are eminently handsome and well preserved. The state of preservation of the works is of no importance whatever, but that of the case and dial is so much more vital. All watches of the very oldest types (with iron works) are also valuable, as well as all egg watches, watches with finely pierced or handsomely chased cases that show no wear, gold enamel watches, which are enameled inside and outside, and all watches in general that are handsomely decorated in any respect.

The following are, on the other hand, valueless or almost so: Chased watches whose figures are worn off; watches with painted tombac cases (copper enamels); watches with cases decorated with gold in four colors unless very beautifully executed and well preserved; watches with enamel-painted dials (enameled on copper); enameled watches which are much damaged; all watches which are devoid of any artistic decoration, hence silver and gold watches with plain cases and unadorned dials, no matter of what description the works may be.

In Fig. 1 is shown a cylindrical watch from the earliest time of watchmaking. The work is entirely of iron, with the so-called foliot (Fig. 2) and hog's bristle (see arrow *a*, which shows the dot marking the spot where bristle is) in place of a balance. The case is of bronze in charming chased work, a masterpiece of the sixteenth century.

A beautiful specimen handed down from the same century is the bronze case in wonderful pierced work depicted in Fig. 3. There are on its periphery four openwork rows of inscriptions and devices, such as: "Hingeht die Zeit, herkompt der Tod, o Mensch thue Buss und fürchte Gott," etc,, as well as one in Greek.

Highly interesting is the little egg watch shown in Fig. 4. It has a handsomely enameled dial, which on the back shows in raised enameled work St. George with the dragon. The sides of the case bear the inscription of the Order of the Garter: "Honi soit qui mal y pense." (See Fig. 4*a*.) At the Spitzer auction this gem of the goldsmith's art brought 21,500 francs (No. 2,711 in the catalogue of the auction). Signed N. Vallin; time about 1600.

Fig. 5 shows us a silver cross watch with fine openwork case, depicting hunting scenes, remarkable for its rare work. Signed Carl Bauer, Amsterdam; time about 1650.

An egg watch in a finely-engraved silver case, partly gilt, is represented in Fig. 6. Signed Jacop Ducimin, Amsterdam. From the Spitzer collection. Time about 1650.

In Fig. 7 we see a gold-enameled egg watch. It dates from about 1600.

A veritable *chef d'œuvre* of the engraver's art, an egg watch in a silver-gilt case, indicating the day of the week, date, phase of the moon, zodiac, and age of the moon, is depicted in Fig. 8. The plates are superbly engraved. It belongs to the time around 1650.

The smallest watch of former centuries appears in Fig. 9; its diameter is nine millimeters. It has a gold enameled case and dial. This unique specimen is a product of the middle of the seventeenth century.

Notable among the gold-enameled watches in this collection is the one shown in Fig. 10, from the period of Louis XIII., with representations from the story of Anthony and Cleopatra on the inside and the outside of the case (Fig. 10*a*). This watch was made by C. Gamod at Paris about 1640. Another gold-enameled watch, likewise an excellent piece, shows scenes of the Madonna, etc. (Fig. 11); from the period around 1700.

Still another large gold-enameled watch is set with pearls and contains a music box playing on bells (Fig. 12). The back is decorated with lions and swans belching forth water (in operation); the inner rim charmingly engraved and pierced. A unique work of the first class from 1790.

Fig. 13 represents a gold watch, set with pearls, in translucent enamel. Signed Albery, London; time 1800.

Very odd is a gold box, the lower part of which serves as a *bonbonnière*, while the upper part, executed in the form of a watch, contains a willow-wren chirping a melody, with the corresponding motion of the beak, flapping its wings, and moving in a lively manner (Fig. 14). The whole is finely enameled and dates from about 1790.

Other odd shapes are shown in Figs. 15 and 16. The former is a tulip of gold inlaid with pearls and enameled (about 1800), while the latter is a gold watch in the form of a mandolin, in filigree work, set with pearls, from about the same period.

As want of space prevents me from illustrating all of the interesting ninety-odd pieces of the collection, I will close by presenting in Fig. 17 a rock-crystal watch with handsomely engraved dial. This watch was made around 1650, and once formed part of the Spitzer collection.

ROCKY MOUNTAIN AVALANCHES.

(*Continued from page* 164.)

of miners started to rescue the engineers when another avalanche descended, burying nearly twenty of the rescuers. In all no less than six masses of snow came down the slope during that day, and the bodies of the victims were not recovered until several months afterward. The snow was so deep that portions of the avalanche remained in the valley until late in the summer. A few days later the San Juan mine situated near the Liberty Bell was literally overwhelmed by an avalanche. A number of incidents have occurred in the San Juan district and other parts of Colorado which strikingly indicate the force of the snow movement. In one instance a gang of railroad men on the Colorado & Northwestern line were removing the snow from the track at a point near Long's Peak. Here the railway was built at an elevation of about 10,000 feet, but the mountain extends over a thousand feet above it. A rotary snow plow pushed by two locomotives, each weighing over fifty tons, was employed to clear the track, when a slide came down, of such dimensions that one of the locomotives was lifted from the rails, torn away from the other engine and carried nearly 500 feet down the slope with two of the men, who were killed.

Usually the mass of snow descends early in the spring, when the rays of the sun have weakened it sufficiently to create a movement. As soon as spring approaches, the townspeople carefully note the appearance of the dangerous snow fields and prepare for their descent, which is usually in one direction. When the Denver & Rio Grande Railroad was constructed to Telluride, the engineers learned of the yearly snow slide and surveyed a route which they thought would prevent it from endangering the track. The first spring after the road was completed, however, for some unknown reason the avalanche took a different course, striking the railroad with such force that no less than twenty-five loaded freight cars were thrown down the mountainside and destroyed. Fortunately the avalanches in Telluride have been made the subject of a special study by one of its residents, Dr. J. Q. Allen, who has obtained much valuable data as to their cause and effect. Dr. Allen had an opportunity to observe the first avalanches that damaged the Liberty Bell mine. His statement, which follows, is of special interest:

"The first slide at the Liberty Bell mine ran at least one mile. The snow was left 25 feet deep in the gulch, and probably much more than that in places, possibly a maximum depth of 40 feet. There was no mass of ice in the slide, only snow, solidly packed by the impact of the moving mass. The vertical distance which this slide descended was fully 3,000 feet. The slides all started above timber line, at an altitude of from 12,000 to 13,000 feet. The first 1,000 feet of the course of the slide referred to was at an angle of about 4 deg., the next 500 feet, 20 deg., and the balance of the way about 15 deg. from horizontal. Of course, the upper part of the range is much steeper than this, in places almost perpendicular; but the snow does not accumulate to any extent on such a steep surface, merely striking against the wall of rock and falling down to where it can stick to the surface until it accumulates to great depth. The current of air produced by an avalanche is often something terrific. The swiftly-moving mass of snow creates an air pressure in front and a partial vacuum behind, producing currents strong enough to destroy buildings untouched by the snow. The difference in air pressure within and outside of a building is sometimes sufficient to actually blow the structure to pieces. Of course, avalanches usually run in well-beaten tracks; but occasionally the wind will so drift the snow as to throw the slide out of the regular course. This explains why we often see a slide cutting down through timber, which is evidence in itself that no slide has run there for many years before. The causes which operate to start the slide are various. When a heavy fall of snow has taken place early in the winter, as soon as it is heavy enough it will move regardless of the time of day or of any other influence. Slides that occur in the month of April are usually caused by the heat from the sun. Where a large field has accumulated high up on the side of a mountain, and has been frozen to the earth, it will remain until the heat of the sun loosens it from the bottom. In our locality these slides usually start about four o'clock in the afternoon. In loose, freshly-fallen snow, very little force is needed to start a big slide. The firing of a gun or a sudden gust of wind may be sufficient. If a small bunch of snow, no larger than an orange, drops from a little cliff and starts rolling down the side of the mountain, it may enlarge rapidly enough to start an immense avalanche."

Dr. Allen has made measurements of forest trees which have been cut down at the base by the force of the moving snow and found that many of them ranged from 15 to 18 inches in diameter; yet, as the photographs show, they were reduced to a mass of debris, and in many instances the trunks were stripped of their branches. Dr. Allen has personally had several thrilling experiences with snow slides in Colorado and was one of those who escaped in the Liberty Bell disaster. His account of his experience contains some valuable data and is here given:

"My first experience with a slide was at Creede, Col. I, with three other men, was on the side of a mountain looking at some mining property. We were above timber line and about half way from the bottom of the gulch to the top of the mountain. I did not think at the time of danger, as the snow where we were was only about 18 inches deep. The field suddenly cracked and the snow below us moved down a foot or two. This took away the support of an immense mass of snow above us, where it had blown over the top of the ridge to a depth of 15 or 20 feet. It broke at the crest of the ridge, and all of the snow on our side of the mountain came rushing down upon us. The mountain curved around us in a circular manner and the width of the slide was more than 1,000 feet, we being about in the center. I glanced up, on hearing the snow break, and, acting upon my first impulse, turned my back to the avalanche. It struck me first on the legs, and I sprang into the air as high as I could. The mass passed under me, and by the terrific rush of the snow I was kept on the top all the way down into the gulch, about 500 feet. I was the only one free, and proceeded to dig the others out. As the snow frequently packs after running, almost to the consistency of ice, this was no easy matter. The man next to me was buried in a perpendicular position, with only his hair visible. I had to free his body down to the ankles before I could pull him out. The last man reached was dead when extricated. The rest of us escaped with slight bruises. It was the next July before articles we lost were found. When the Liberty Bell disaster occurred, I was conducting a hospital for the mining companies. Receiving news of the first slide, I went to the mine, finding several men who were severely injured. After attending them, I sent them down to the hospital. About eleven o'clock the second slide came down in the track of the first slide, starting a little to one side, and burying several of those in the gulch searching for the dead and injured of the first slide. We then decided to leave the locality, taking the injured with us. After passing over the next ridge and on coming down into the gulch beyond, the third slide came down. This slide ran almost a mile. I was the last man in the procession. A heavy snow storm prevailed, so that we could see only a few feet, but as I knew we were about to cross the old track of a slide I kept listening. Presently I heard the breaking of timbers far up the side of the mountain. This could be distinctly heard above the roar of the storm. Turning my horse, I ran him up the trail just in time to escape the main body of the slide. I was caught on its edge, however, carried off the trail with my horse and tossed, as by a wave, on the side of the mountain, where the slide made a turn. Four of us were struck by this slide, and all were killed but myself. In all twenty-three men were killed at this place by slides that day."

Method of Making Violins.

Many theories have been advanced by the experts of our day to explain why the violins of the famous old masters so far excel the best products of modern workshops. One of these theories is to build the instrument in such a manner that not only the strings, but the body itself shall be under tension. While many inventors have attempted to put this theory into practice, it appears that but one of them has succeeded. Mr. Louis H. Hall, of Hartford, Conn., who was granted a patent covering his construction in 1900, has according to many experts solved the problem. Briefly, Mr. Hall's method consists of cutting the upper and lower tables so that they do not quite fit upon the blocks, and then to force them into proper position under great pressure, thereby putting the required tensile strain into the body.

Dr. T. Lamb Phipson, the well-known English expert, has declared the violin thus constructed the equal of many of the finest instruments of Joseph Guarnerius. Arthur Broadley, another world-famed English expert and player, has unqualifiedly recommended the instrument. The great virtuoso Ysaye has expressed his interest in the violin, and will procure an example of Mr. Hall's work.

Death of Alphonse Chassepot.

Alphonse Chassepot, inventor of the famous Chassepot gun, is dead. He was the son of an armorer, of Mutzig, and followed his father's trade, entering the French state factories and being transferred to Paris in 1858, where he soon became head of the establishment. He studied the Prussian rifle and perfected it, giving his name to the new weapon, which was first used in Italy against the Garibaldians. It has since been abandoned for a more perfect style of rifle. Chassepot received the cross of the Legion of Honor in 1866.

THE QUEEREST OF CREATURES.—II.

BY J. CARTER BEARD.

(*Continued from page 11, January 7.*)

Among the puzzling adaptive resemblances of lemurs to animals quite low in the scale of animated existence, few, perhaps, are more curious and interesting than those developed by the Lemurid called by the well-known naturalist Cuming the Malmag (*Tarsius spectrum*), which in its adaptation to the exclusively arboreal life common to all but one species only of the Lemuroidæ has achieved a most singular approach in form and in habit to a tree toad.

The absence of any perceptible neck, the short body shaped like a lemon, the grotesquely elongated hind legs and slender ankles of the creature, peculiarities it shares with the batrachian, form an adaptive parallelism that is completed by the button-like pads at the ends of its long fingers and toes, in form and function apparently answering to those which enable the tree toad to cling securely to the upright trunk of a tree or even to the under side of a projecting bough. The lemurs are the only mammals now existing that possess such peculiarly-formed digits.

Indeed, it may well be believed that were it not for its long tail and its ears, and the fact that it is covered with fur, it might, as it hops about in its leafly retreats, be easily mistaken for a specimen of some very large species of Hylidæ. This curious little creature can now be considered as having been adopted by Uncle Sam, and of making one among the many odd specimens of living beings lately added to our fauna, for it is an inhabitant, among other places, of the Philippine Islands.

But the Lemuroidæ have taken ideas and suggestions from the bird as well as from the reptile and from the batrachian.

There are several species of trim, very pretty, very active, and very clever little lemurs called Cheirogales, which build their nests, not at all like those of squirrels, mice, or other so-called nest-building mammals, but nests in every way resembling those of birds, constructed of small, flexible twigs, leaves, and tendrils, with a depression in the center in which, upon a bed of soft hair, are born their naked nestlings, that are fed, protected, and cared for exactly as are those of birds, until old enough to venture out into the world to seek their own fortunes. The smallest of these dainty little creatures is called by the French *le rat de Madagascar*, a name that certainly cannot be said to do them justice. They might with more propriety be called jeweled-eyed lemurs, for they have probably the most resplendent eyes of any living mammal; the tapetum is so large and reflects so much light in the dusk, that the cheirogale appears to possess a pair of magnificent opals for organs of vision.

They are interesting also because of the peculiar habit they indulge in of sleeping through the hottest and driest of the summer months, as many of the mammals in colder climates hibernate in the winter. It is rather remarkable too that they seem to have hit upon the same expedient to lay up a store of nutriment, to be drawn upon when required, as the Syrian sheep (*Ovis aries steatopyga*) at the base of their tails.

Domestication has rendered the fat tails of the sheep of use to their masters only, but the fat-tailed cheirogales depend entirely upon their caudal appendages for sustenance during their long summer fast. They sleep in their nests, and as they retire to them to begin their æstivation, the bases of their long tails are swollen and bulbous; but when they leave their nests at the beginning of the rainy season in Madagascar, they are, both tail and body, emaciated to the last degree.

A WANTIBO (PERIODICTICUS CALABARENSIS).

The little animals are but four inches long, but their tails are fully two inches longer than their bodies. The character of dentition, usually of such specific and distinctly defined methods of arrangement in mammals as to form a reliable basis upon which to build a judgment of family, genera, and species, is among the Lemurids very erratic. One member of the group, for instance *Chyromys Madagascariensis*, the aye-aye, exhibits exactly the dentition properly belonging to the order of gnawers, the rodents, and on account of this peculiarity was placed by Buffon among the jerboas or jumping mice; by Cuvier among the squirrels (although he afterward spoke of it as a doubtful animal); and by zoologists generally up to the time of Owen, among rats and beavers as an undeniable rodent. Its physical structure, however, apart from its adult dentition, proves it to be a lemur which has appropriated an adaptive suggestion from another order of mammals. The grotesque and excessive specializations exhibited by the Lemuroidæ are far too numerous to be indicated here; to do justice to these, and to describe the strange habits of the different members of the group, although so little is yet known of many species, would require a volume which, if properly written, could not fail to prove a most interesting one. Every peculiarity of every species has a meaning and a history of its own, which if justly worked out might go far to determine the inter-relation of laws by which the same environment has produced such widely varying results.

Whatever the nature of the force that, working so differently in different members of the lemuroid group of animals, adapts them all so completely and so perfectly to the same surroundings, the trend of the progress made is surely, however slowly, toward the final destruction of the order; for specializations, in proportion to the extent to which they are carried, unfit the animals specialized to survive changes of environment, of climate, food supply, means of escape from dangerous enemies, and disease-breeding conditions, often too subtle to be defined.

While the lemur, at the foot of the order of Primates, has been the most plastic of the three groups of mammals which constitute it in yielding to this force, impelling toward extreme specialization, man has of all mammals most stubbornly and successfully resisted it, and has in consequence become the most cosmopolitan of animals.

Much difficulty, up to the present day has been experienced in obtaining living specimens of the Lemurids, but the situation since the protectorate established by France over Madagascar and the incursion of scientific naturalists into the wilder parts of Asia and Africa, no longer presents the insurmountable obstacles which formerly attended any attempt to study the rarer species. Specimens are obtained, and the untiring energy of Mr. W. T. Hornaday, seconded by his colleagues, has already succeeded in placing a number of these curious animals on exhibition, which, notwithstanding their somnolence, are well worth a visit to the New York Zoological Park or to other collections of living animals in other cities where they are to be found. Lemurs are well worth the careful attention that is now being given them, both with respect to their physical structure and their habits.

If the theory of evolution is accepted, it cannot fail to convince the student that we have in this order of animals survivals of extremely ancient types of mammals—types, it is interesting to believe, very nearly akin to those from which have arisen all existing families of the order of Primates, which as the reader may remind himself, includes man as well as monkey.

SPECTER TARSIUS (TARSIUS SPECTRUM).

A Prehistoric Cave Dwelling.

A prehistoric cave dwelling has recently been discovered near Winznau, on Lake Lucerne, in Switzerland. The entrance to this cavern has been blocked for ages by the accumulation of falling rocks and earth. Its existence being known, a party of antiquarians had the entrance passage into the cavern cleared of obstructions, and a grotto or series of caves, dating to the Stone period, was laid bare. A fine collection of stone implements, including knives, ax-heads, and spears, gigantic shells rudely ornamented, evidently drinking vessels and dishes, was discovered. In one chamber of the cavern the explorers found the remains of the bones of many extinct animals; while one section of the cave, which is believed to have been the dwelling of an important family in the Stone age, had evidently served as a workshop for the stonecutters, for here were found many stones in the process of being shaped into implements.

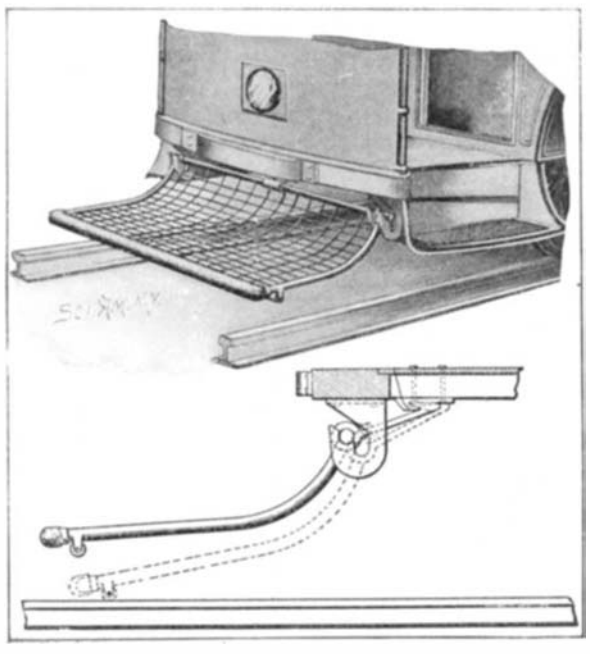
AN IMPROVED HAY RACK.

A number of attempts have been made to devise a hay rack which can be fully loaded from a mechanical loader without requiring that the hay be pitched manually from the loading end to the other. The hay rack illustrated in the accompanying engraving is arranged to effect this result in a very convenient and simple manner. It comprises a main frame, formed with boards running longitudinally along each side, and a movable platform mounted on rollers, *A*, which travel on these boards. At the rear or loading end of the hay rack is a vertical abutment attached to the main or stationary frame, and at the other end is a similar abutment attached to the movable frame. Supported on the central post of this abutment is a windlass, from which a cable passes under a pulley, *C*, to the front of the hay rack, where it is secured to a bracket mounted on the main frame. By winding up this rope the movable platform may be drawn to the front of the hay rack. The pulley referred to is mounted in a swinging bracket, which is pivoted to the movable frame. A projection on this bracket is adapted to normally engage one of the crossbars of the main frame, to prevent the platform from moving forward. But when the windlass is operated, the frame is first drawn up until the crossbars are cleared, after which the forward movement of the platform begins. In use the platform is moved to the rear of the rack, and as soon as the space between the abutments is filled the platform is moved forward, carrying the hay with it, and thus opening a space for further loading. A step is provided on the moving platform for the operator to stand on. The windlass is mounted on a frame which can be attached to the forward abutment at any point suited to the convenience of the operator. Mr. John A. Beierschmitt, of Fairbank, Iowa, is the inventor of this improved hay rack.

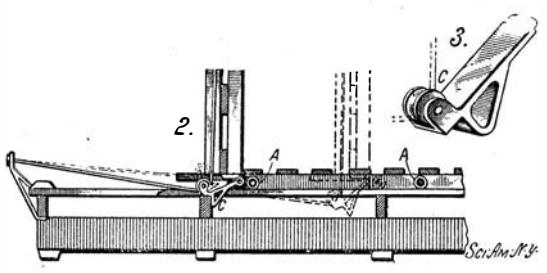
AN IMPROVED HAY RACK.

A SIMPLE CAR FENDER.

The car fender which we illustrate in the accompanying engraving is a very simple contrivance, which may be readily applied to a car of ordinary construction. The connection between the car and fender is such that the latter may be quickly detached from one end of the car and attached to the other end when desired. The fender is also so arranged that its forward end will be normally held a considerable distance above the street surface, but upon striking a person or other obstruction it will quickly fall to safety position. The hangers on which the fender is supported are each formed with two hook members, and between these the side bars of the fender pass. The hook members are each formed with two sockets or recesses, one above the other, adapted to receive the top cross-bar of the fender. Normally, this bar is supported in the upper recesses, as shown in the illustration, and the forward end of the fender is held clear of the street by a pair of locking arms, which engage a plate secured to the under side of the car platform. A hook member on this plate prevents the fender from being moved forward, but by pressing the fender back the locking arms can be disengaged from the plate and the fender removed. When the fender encounters an obstruction, it will thus move back, and the top bar will fall into the lower recess, permitting the forward end of the fender to drop to the track, on which it will be supported by rollers. In this position it is obvious that a person struck by the fender may fall therein without danger of injury. Mr. Louis A. Bechtel, Jr., of Benwood, West Virginia (P. O. box 134), is the inventor of this improved fender.



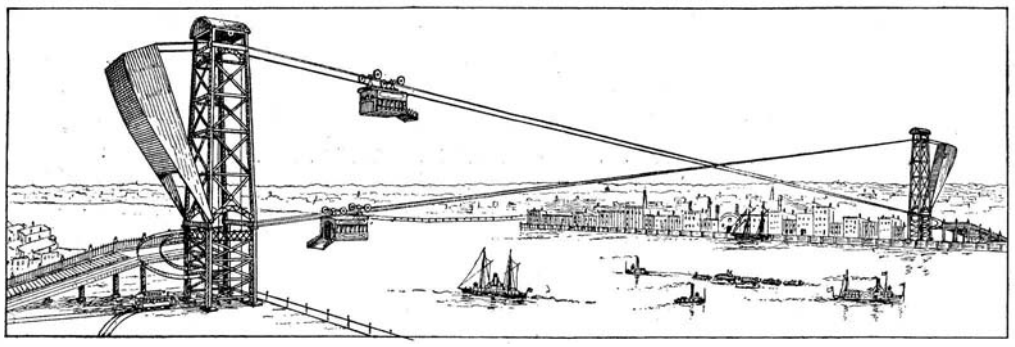
A SIMPLE CAR FENDER.



DETAILS OF THE LOCKING DEVICE.

A NEW TYPE OF ELECTRIC COUPÉ.

Our illustration shows a new type of electric coupé invented by W. H. Douglas, of Belleville, N. J., and which is now being built by Healy & Co., well-known carriage builders of New York. The machine has two novelties, namely, steering and driving by the front wheels and a new form of steering gear. As the picture shows, the motors are suspended from the front axle and drive, through universal joints, the pinions which work within the internal gear rings attached to the wheels. The rings containing the internal gear teeth are mounted within the outer rings, which are attached to the wheels. The gear rings are arranged to transmit motion received from the pinion through coiled springs to the outer rings. This flexible connection makes the vehicle start very easily and makes the stripping of a pinion almost an impossibility. The new form of steering gear employed consists of two vertical screw-threaded shafts connected together by spur gears. One of these shafts is extended upward to form the steering column on which is mounted the steering wheel. Mounted on the screw-threaded shafts are two nuts, one of which rises, and the other of which descends when the steering wheel is turned. This motion is used to move an inverted L-shaped lever pivoted on the nut on the steering column and having its shorter, or horizontal, leg slotted near the end to fit over a pin on the nut of the shorter shaft. The long vertical arm of the inverted L-shaped lever is connected to the lever arm on the steering knuckle. This arrangement is absolutely irreversible and will always stay where set.



A NOVEL GRAVITY RAILWAY SYSTEM.

A NOVEL GRAVITY RAILWAY SYSTEM.

We illustrate in the accompanying engraving a novel railway system invented by Mr. Abraham Abelson, of 109 Henry Street, New York city. This system, as shown, is particularly adapted for crossing rivers, gorges, ravines, and the like, and is designed to effect an economy over existing systems of transportation. It consists of a tower at each anchorage built of skeleton framework, in the center of which an elevator operates. Cables are suspended from a cradle at the tower top and anchored near the base of the opposite tower. Pivoted counter-weights are provided, which serve to keep the cable taut and to compensate for any variations in cable lengths. These weights also remove the lateral pressure on the towers, producing instead a downward pressure thereon. The system does not require any elevated approaches to the bridge entrances. The transporter cars are suspended from swivel trucks which travel on the cables. In practice a car is raised by means of the elevator to the top of a tower, the trucks being turned so as to clear the cables. When the top of the tower is reached, the trucks are turned back to normal position, so that on descent of the elevator they will rest on the cables supporting the car. The car thereupon descends by gravity to the opposite tower. The cars are entirely independent of each other, and the speed of the descending car can be regulated at will, thus effecting a saving of time over such systems as employ two counterbalancing cars.

Santos-Dumont is experimenting with a balloon which differs considerably from his preceding airships. Leaving aside the question of steering, he wishes to obtain a constant altitude for the balloon without loss of gas or ballast under all circumstances, and his new balloon is designed especially to make a long stay in the air. It is of a novel form, consisting of an oval-section balloon which carries a flat framework below it. The balloon body measures 62 feet long and 48 feet in diameter. The *nacelle* is to be hung from the framework. A second balloon or bag is attached to the frame and projects up inside the main balloon, forming a pocket containing 5,500 cubic feet. The pocket will contain hot air and the latter is to be supplied by a petrol heater which is carried below. The hot air bag will thus give an added ascensional force which can be varied at will so as to regulate the height of the balloon. The first trial with the new system will bear upon the operation of the heater and the effect of the hot air upon the material of the balloon. If these are successful, he expects to make an ascension later on.

A NEW TYPE OF ELECTRIC COUPÉ.

RECENTLY PATENTED INVENTIONS.

Of General Interest.

HAT-FASTENER.—L. VEINDER, New York, N. Y. The intention of this inprovement is to provide a fastener, more especially designed for fastening ladies' hats in position on the head and arranged to permit the wearer to conveniently place the hat in proper position, and to then fasten it securely to the topknot of the hair without disturbing the position of the hat and to allow the wearer to readily open the fastener whenever it is desired to remove the hat.

GAGE AND MARKER FOR GARMENTS.—A. WATERMAN and R. WATERMAN, New York, N. Y. The object of the present invention is to so construct the device that the marking-arm will be capable of vertical, horizontal, and swinging adjustment, thus enabling the arm to be accommodated to different characters of work, and especially for marking skirts in such manner that a hem may be evenly turned up at the bottom of the skirt, having either plain or fancy finish, and to render the adjustment such that the marking-chalk be under complete control of the operator. It improves upon and simplifies the construction for which former Letters Patent were granted to A. Waterman.

PENCIL-HOLDER.—W. SCHARRATH and F. A. ROJAS, New York, N. Y. The object in this instance is to provide a holder arranged to permit the user to conveniently attach it to a finger and to move it into any desired position thereof or for moving the holder while on the finger into non-use position to permit the user to conveniently employ the hand for wrapping, tying, and other purposes, the holder being arranged for convenient attachment to a pocket or other part of a garment for supporting the pencil when not in use, the holder also serving as a paper clamp for fastening loose sheets of paper together.

TEMPORARY BINDER.—L. T. PRUDON, North Bergen, N. J. The invention relates to a binder for use on loose-leaf ledgers, memorandum-books, and analogous purposes. The objects are to provide a binder which may be readily locked in a closed position and readily unlocked and opened by a simple movement of a lever which will securely hold the leaves in position.

MOVING DISPLAY-SIGN.—T. B. POWERS, New York, N. Y. In this patent the invention has reference to moving display-signs, Mr. Powers' more particular object being the production of an efficient sign of very attractive appearance, and in which intelligible characters may be displayed in a variety of ways, affording certain advantages. It may be used for election purposes, for advertising, and for bulletin-work.

LIQUID-RIPENER.—A. JENSEN, Topeka, Kan. In the present patent the invention is in the nature of a device for agitating and cooling or heating liquids—as, for instance, in ripening cream preparatory to churning it; and it consists in the novel construction and arrangement of receptacle with means for cooling or heating the cream, as may be desired, and at the same time agitating it. Mr. Jensen has also procured another patent on the same subject which is an improvement in construction, and is in the nature of a device for cooling or heating and simultaneously agitating liquids.

CANDY-HOLDER. J. JEFFERS, JR., Saginaw, Mich. One object of the invention is to provide a receptacle for holding candy or other similar articles, which will automatically close the opening through which the contents are passed and securely hold the same closed until it is desired to remove such contents. Another, is to provide such receptacle which can be opened as readily in darkness for removing contents as in the light.

UMBRELLA.—A. KORTENBACH and K. WORRING, Weyer, Rhineland, Germany. The objects in this invention are, to so reduce the upper part of the tubular metal stick in diameter in several steps that it tapers to the end; to apply the umbrella-notch to one of the steps of the stick; to provide the thin end of the stick with a female screw-thread; to provide a screw-threaded top piece which engages in the female screw-thread of the stick; to provide a conical metal tube secured on the top piece and inclosing the reduced part of the stick down to a point near the notch; and, to provide a conical cap for securing the wide end of the conical metal tube on the stick and leading up to the flanges of the notch.

CHAIR.—W. D. JONES, Butler, Pa. This invention refers to improvements in folding chairs, particularly adapted for use in theaters, halls, and the like, the object being to provide a chair so arranged that the seat and back may be closely folded together and turned laterally when not in use, so as to provide spaces or aisles between rows of chairs along which people may readily pass.

FAUCET.—A. E. ISAACS, New York, N. Y. The purpose of the improvement is to provide an effective form of faucet having inlets for hot and cold water, a chamber in which the two may be mingled, and a single outlet. The particular construction relates to the expeditious and convenient manner in which through the manipulation of a single handle the supply of hot or cold water or the combined supply of both may be turned on, regulated, or shut off.

SEALING DEVICE.—C. F. HAIDT, Indianapolis, Ind. In the present patent the invention has reference to devices for sealing such gummed wrappers as envelopes. The principal objects of the inventor are to provide a convenient implement which will simultaneously moisten the gummed portion and press the parts together.

CALK.—F. F. HEISELMANN, Cincinnati, O. The invention refers to calks, and more particularly to those adapted for use in connection with horseshoes. Its principal object is to provide such a device which will be strong and durable and may be readily applied to the shoe and easily replaced when they are worn out. The calks being very resistive of wear will last for a long time.

CLOTHES-PIN—J. S. BANKS, Portsmouth, Va. This improvement relates to clothes-pins such as used to suspend clothes upon a line to dry. The object is the production of a device of this class which is very simple in construction and which may be readily applied to a line at any point, operating effectively to support the clothes which may be attached thereto. The device is preferably to be formed of wire.

CIGAR-PERFORATOR.—C. BLUMER, Guttenburg, N. J. The object of the improvement is to provide a perforator more especially designed for penetrating the sides of the cigar at or near the point thereof to provide draft-holes for drawing the smoke through, the arrangement being such that the wrapper is not loosened or unraveled when forming the draft-holes by the instrument.

OPTICAL TOY.—M. ABRAMOWITZ, New York, N. Y. The device being held in one hand and the eye applied to the eyepiece and an illuminated scene or object viewed this becomes visible, multiplied by the facets and of the color of the eyepiece. Moreover, because of prismatic refraction there is also seen a plurality of spectra, and upon rotating the eyepiece by means of the operating member both the objects and spectra revolve, producing a most attractive effect.

RESPIRATOR AND INHALER.—G. N. GUTHRIE, JR., Cookville, Tenn. Mr. Guthrie's invention is attached to the face in order to permit the subject to breathe air from other rooms or purified air and prevent inhaling of undesirable gases and vapors. His objects are to provide inhalers and respirators with devices for purifying air, removing solid matter therefrom, and for conveniently connecting them to such purifying devices or to outside air. It is capable of universal use and attachable to any subject, being made in various sizes. It is light, inexpensive, prevents air from entering the lungs except through the filtering medium, permits no rebreathing of exhaled air, and is not likely to become clogged.

Heating and Lighting.

HEATING APPARATUS.—N. M. EDDY, Alpena, Mich. The purpose in this case is to so construct the air-escape valve for heating apparatus that but one valve is required in the length of the air-line for the entire apparatus and so that the valve will be simple and not liable to be affected by heat, and, furthermore, to so construct the valve that it will greatly add to the speedy and economic operation of the heating system in connection with which it is used, permitting air to readily escape, but positively preventing a return of the air through atmospheric pressure.

Household Utilities.

SCREEN-FASTENER.—C. W. GREENE, Brown Valley, Minn. The purpose of this invention is to provide a fastening device which can be expeditiously secured in a casing and which may remain therein when the screen or the storm-sash is removed and also to so construct the device that it will be provided with a spring retaining-arm capable of being quickly and readily brought to a bearing against the frame fitted in the casing.

SWINGING SLIDING DOOR AND MEANS FOR SUSPENDING SAME.—R. H. JONES, Portland, Ore. The class of sliding doors provided for houses, barns, stables, warehouses, etc., is improved by this invention, so that when duly adjusted in position for closing the entrance they may be swung laterally in the same way as a hinged door. In other words, the improved door and attachments are adapted to be slid longitudinally for opening and closing the entrance and also enable it to swing on a pivot-support, so that the entrance may be opened without sliding the door.

Machines and Mechanical Devices.

PUMP-ROD LIFTER.—T. H. TREGELLAS, Inka, Kan. In this device hanger bars are carried by a clevis to which a draft rope is connected, and at the lower end the bars carry a gripping dog to which a bail is pivoted. The bail and arms slide downward on the pump rod when the rope is slackened and an upward pull on the rope causes the pump rod to be gripped between the dog and the inner surface of the bail whereby the rod may be readily drawn upward.

DYEING-MACHINE.—J. LEISEL, Charlotte, N. C. The object of the invention is the provision of a machine arranged to keep the material submerged, to prevent the material from coming in contact with the air during the dyeing operation, to carry on the dyeing operation economically both in time and labor, to expedite unloading of the machine after material is dyed, and to remove foreign and insoluble matter from the dyeing liquor during the process of dyeing, to facilitate circulation of the dyeing liquor through the material, and to prevent uneven and spotted shades in the dyed material.

Railways and Their Accessories.

AUTOMATIC RAILROAD-SWITCH. — G. CURRIER, St. Paul, Minn. Mr. Currier's invention is in the nature of a switch designed more particularly for rapid-transit street-railways, but applicable also to all kinds of railways. It relates to that form of railroad-switch in which the switch is connected to and operated by a movable device in the road-bed which is struck by a projection on the car as it passes over the device, whereby the switch is automatically adjusted by the passage of the car without having to stop and adjust the switch by hand.

RAILWAY-SWITCH.—E. G. MICK and J. M. GILLILAND, Newcastle, Pa. In the Messrs. Mick and Gilliland invention the improvement is in railway-switches. As the train passes from the siding onto the main track the switch opens automatically by the pressure of the flanges of the wheels, permitting the train to pass through the switch onto the main line. In this operation as the train comes from the siding passing onto the switch-rail the flange of the wheel will force the rails into position to permit the train to pass onto the main track and also operate the pressure-bar in moving thereon.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 6551.—For manufacturers of machines for desiccating cocoanuts and other neces ary machinery for a cocoanut plant, as slicing, shredding, grating, etc.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 6552.—For makers of paper tape, such as used in stock machines, telegraph instruments, etc.

Perforated Metals, Harrington & King Perforating Co., Chicago.

Inquiry No. 6553.—Wanted, a machine for perforating pianola music rolls.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 6554.—For makers of marine engines, h. p. from 20 to 300 single, compound and triple explosion.

Adding, multiplying and dividing machine, all in one. Felt & Tarrant Mfg. Co., Chicago.

Inquiry No. 6555.—Wanted, a machine for cutting out envelopes.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 6556.—For manufacturers of sheet iron or steel powder kegs in which blasting powder is usually shipped.

Robert W. Hunt & Co. bureau of consultation, chemical and physical tests and inspection. The Rookery, Chicago.

Inquiry No. 6557.—For the address of the manufacturer of Golden's all metal weather strips; or for makers of any other weather strips.

If you wish to buy patents on inventions or sell them, write Chas. A. Scott, 719 Mutual Life Building, Buffalo, N. Y.

Inquiry No. 6558.—For apparatus for making and burning charcoal.

We manufacture anything in metal. Patented articles, metal stamping, dies, screw mach. work, etc. Metal Novelty Works, 43 Canal Street, Chicago.

Inquiry No. 6559.—For a machine for sifting sand and gravel, also for lifting the same into cars at height of 20 to 30 feet.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Machine Company. Foot of East 138th Street, New York.

Inquiry No. 6560.—For makers of the silver or "G" strings for violins, guitars, mandolins, banjos, etc.

The SCIENTIFIC AMERICAN SUPPLEMENT is publishing a practical series of illustrated articles on experimental electro-chemistry by N. Monroe Hopkins.

Inquiry No. 6561.—For makers of woven wire pillows.

Manufacturers of patent articles, dies, metal stamping, screw machine work, hardware specialties, machinery and tools. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 6562.—For manufacturers of persulphite of ammonia.

VALUABLE U. S. PATENT FOR SALE.—I will dispose of the American rights of my Patent Thill. A necessity for farmers and drivers. Price reasonable. Address Harry Turner, Koolunga, South Australia.

Inquiry No. 6563.—For a plant and machinery for manufacturing starch from cassava.

WANTED.—Revolutionary Documents and Autograph Letters Prints, Washington Portraits. Eighteenth Century Illustrated Magazines and Books, Early Patents signed by Presidents of the United States. Valentine's Manuals of the early 40's. Correspondence solicited. Address C. A. M., Box 773, New York.

Inquiry No. 6564.—For manufacturers of home illuminating outfit, also wood-burning furnace.

I have every facility for manufacturing and marketing hardware and housefurnishing specialties. Wm. McDonald, 190 East Main St., Rochester, N. Y.

Inquiry No. 6565.—For machinery for square self-opening paper bags.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(9540) J. L. C. says: Which of either brass, iron, tin, steel, copper, or aluminium is the most affected by temperature, and what will its expansion be with a change of 60 deg. on a Fahrenheit thermometer? A. Tin has the highest co-efficient of expansion of the metals you name. A bar of tin 100 feet long will expand 0.87 inch if the temperature is increased 60 deg. F. Lead will expand 1.14 inches, and a mixture of one part tin and two parts lead (white solder) will expand 1 inch under the same circumstances.

(9541) B. B. B. asks: Under the conditions stated in query No. 9513 in your issue of December 31, 1904, if a gun is discharged in the rear of a train traveling one mile a minute—the bullet speeding one mile a minute in the opposite direction from which the train is going—will the bullet leave the muzzle of the gun? If in query 9513 the bullet gathers momentum from the train, why will not the momentum overcome the speed of the bullet? A. A bullet will certainly leave the gun under the conditions stated in query 9513. The expansive force of the gas will carry the bullet out of the gun. This expansive power is evidently not affected by the motion of the train. It is this which produces the motion of the bullet in the direction opposite to that of the train. When the backward motion produced by the gas reaches one mile a minute, the ball will come to rest so far as a point on the earth under the ball is concerned. The ball can only get a mile a minute forward from the train. It gets a mile a minute backward from the powder. The two are equal.

(9542) F. B. M. says: We have our own electric outfit. We have a switchboard with ammeter and voltmeter. We carry 110 volts, but the lights are much dimmer than our city lights, whose voltage is only 104. How can I determine whether our voltmeter is correct or not? I believe it is very far from being correct. A. The easiest way to settle the comparative readings of your voltmeter and that of the city plant is to take one of the instruments to the other plant and compare the two on the same line. Another way would be to connect the voltmeter which is suspected of being in error to a storage battery of known voltage. There is no way of testing an instrument without a standard of some sort. If there is no standard nearby, you can send it to the manufacturer and have it put in order. During its absence you may be able to get along by regulating the current till the lamps are of a proper brightness.

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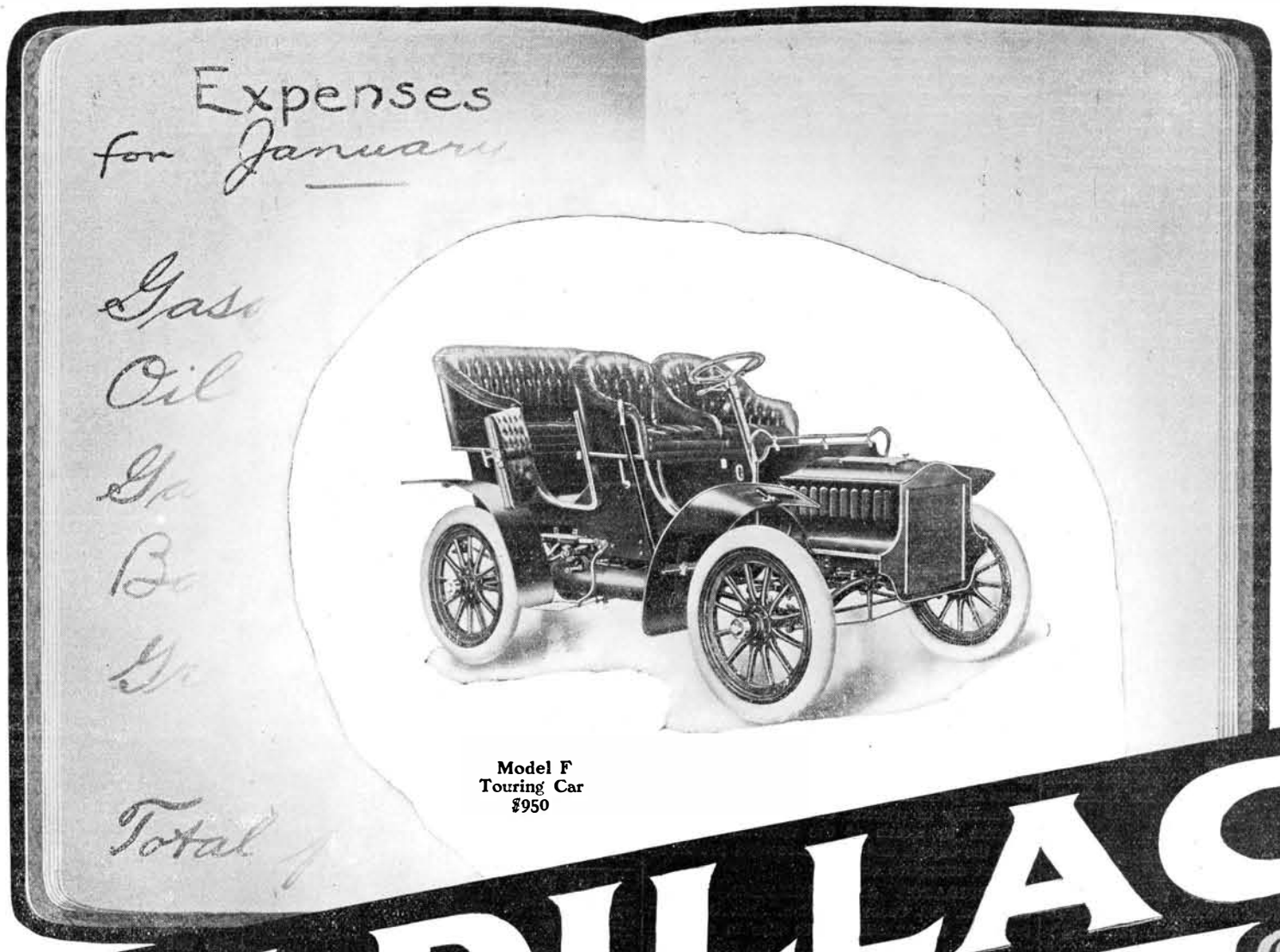
Automobile controller, E. N. Dickerson	782,548
Awning pole mounting, M. F. Wiedemann, 782,300,	782,804
Axle, L. A. Keene	782,564
Bag. See Feed bag.	
Bag holder, W. Downie	782,439



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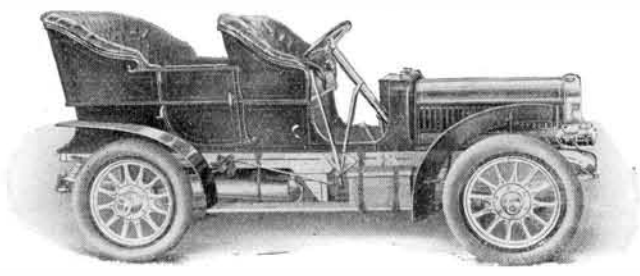
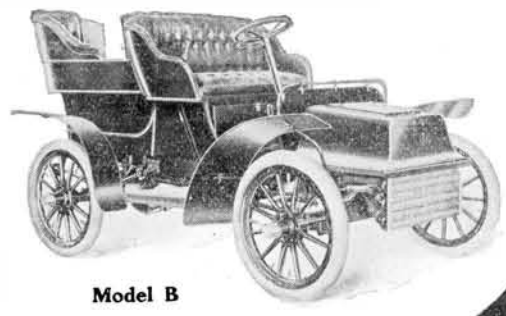
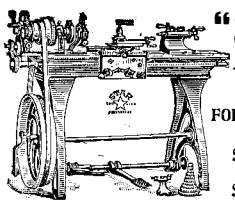


Model D



Model B



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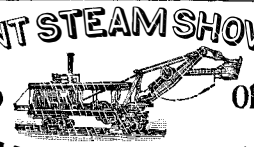

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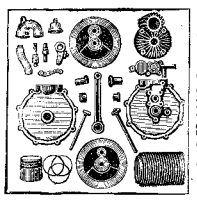

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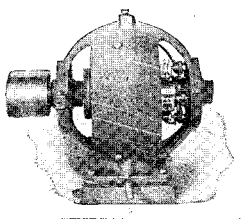

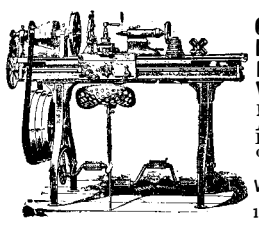

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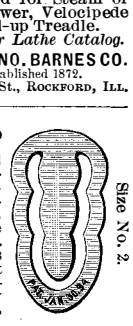

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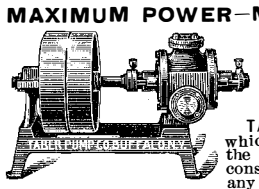

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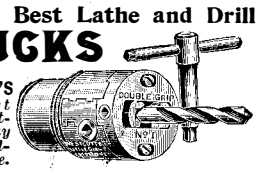

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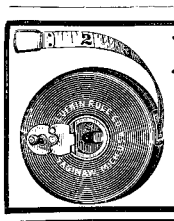

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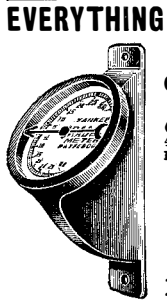

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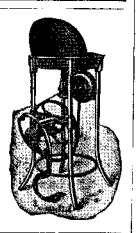

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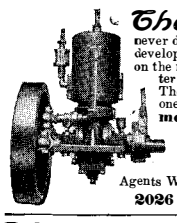

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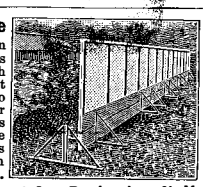

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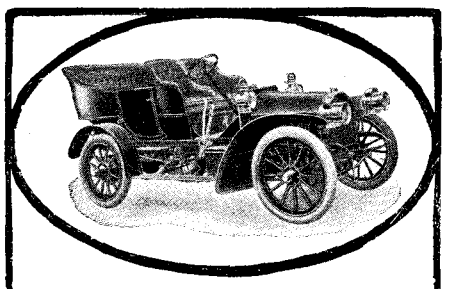

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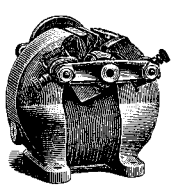

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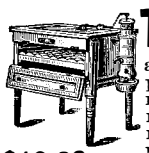

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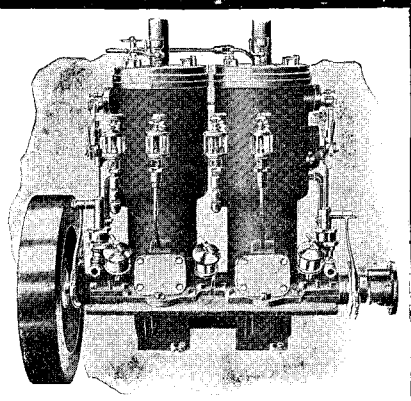

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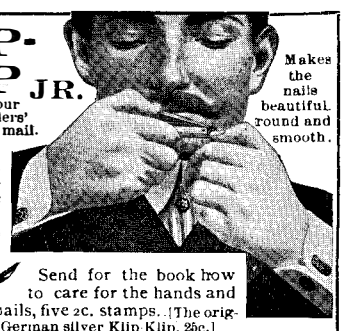

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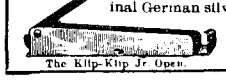

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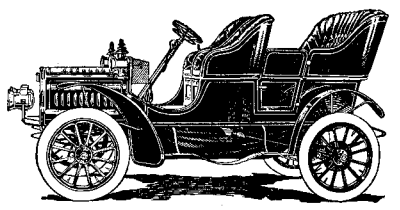

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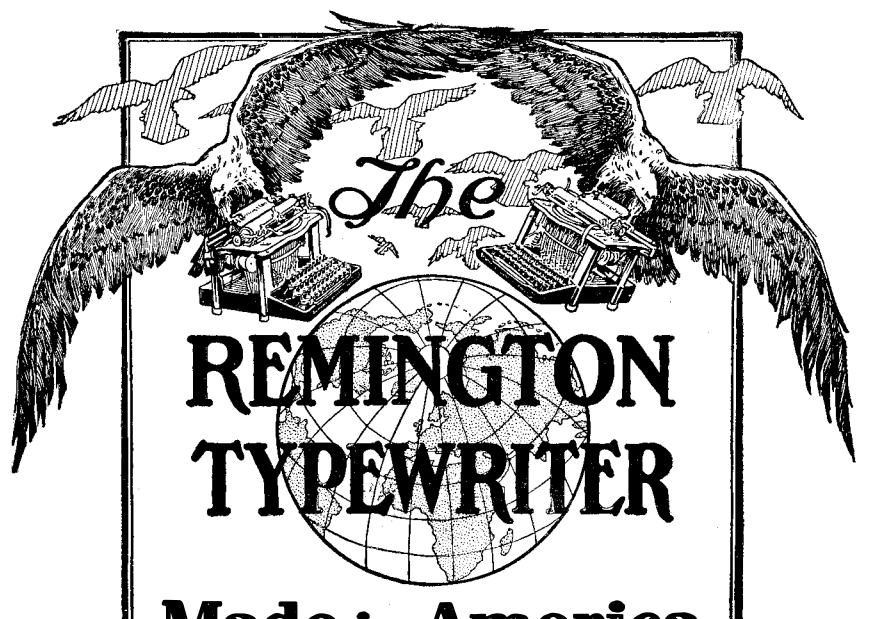

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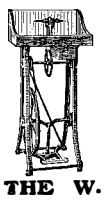

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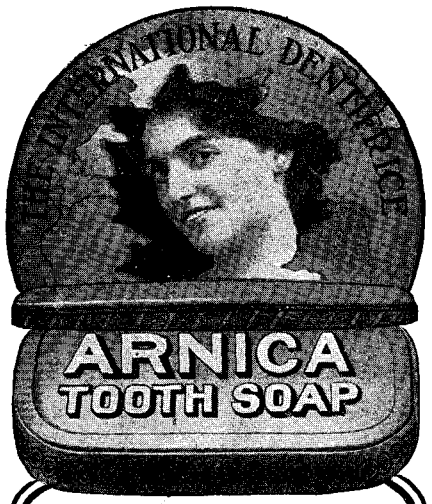

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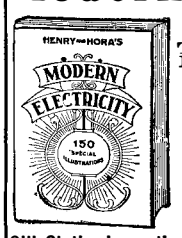

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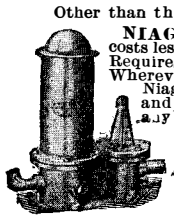

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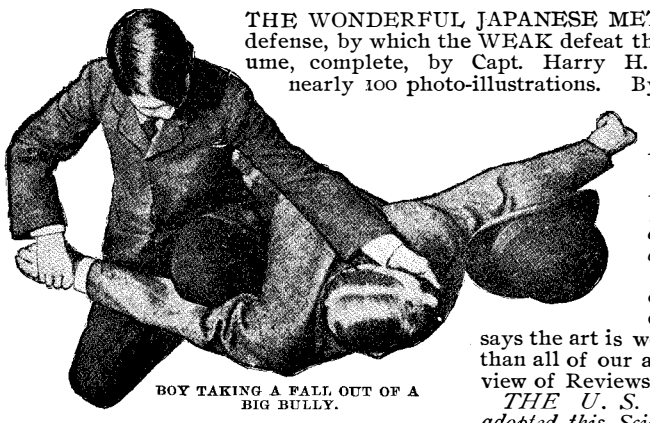

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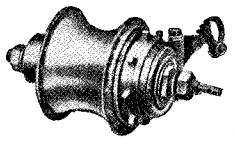

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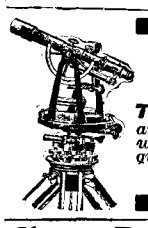

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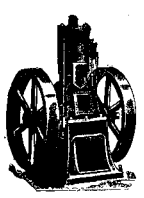

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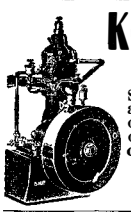

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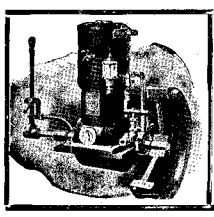

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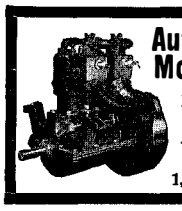

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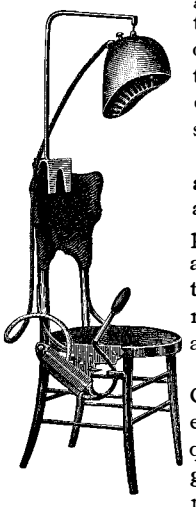

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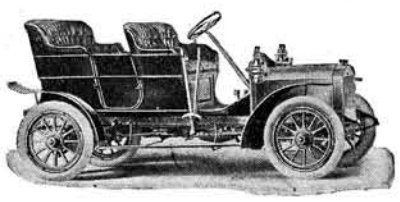

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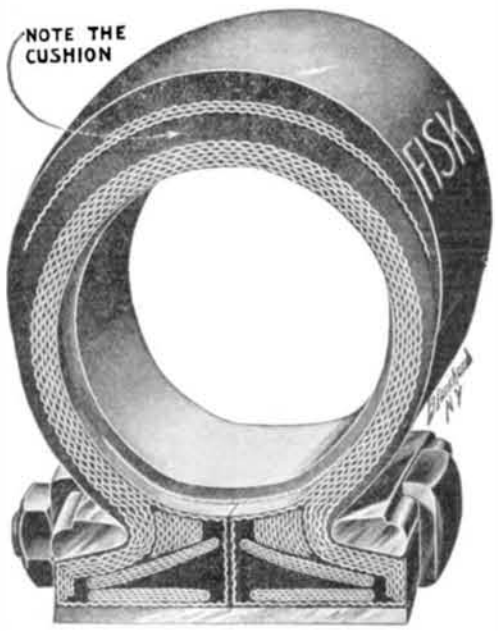

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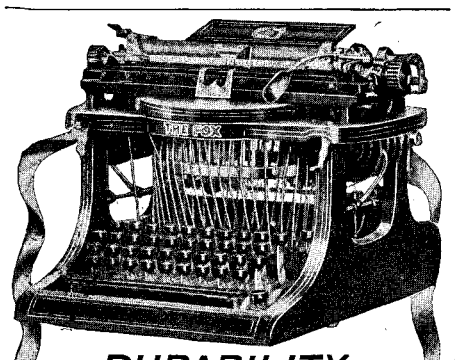

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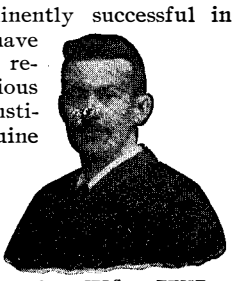

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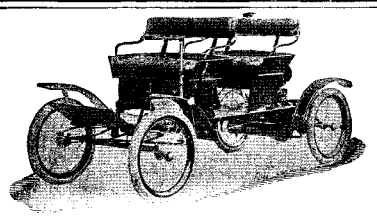

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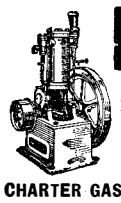

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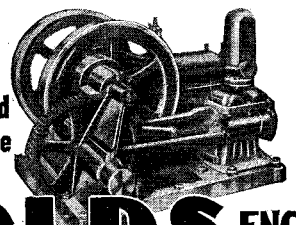
The Wizard Engine  **With Pump**

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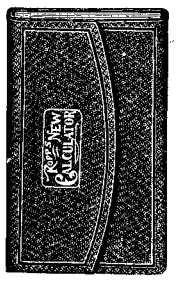

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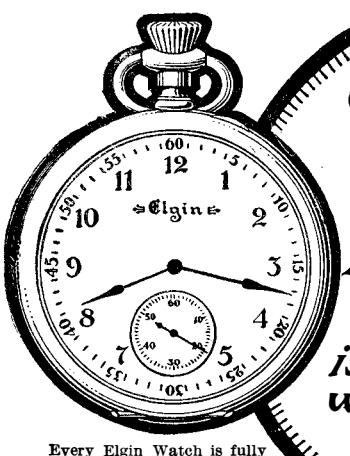

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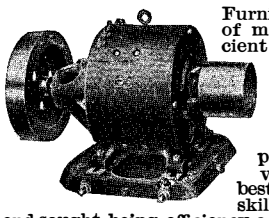

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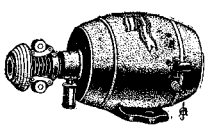

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